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THESIS

AN INTERACTIVE COMPUTER INTERFACE
WITH A DIGITAL RECEIVER

by

William Glenn Borries

March 1977

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An Interactive Computer Interface with
a Digital Receiver

by

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Lieutenant, United States Navy
B.S., United States Naval Academy, 1970

Submitted in partial fulfillment of the
requirements for the degree of

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LIST OF ABBREVIATIONS

| | |
|-------|-------------------------------------------------------|
| A/D | Analog to Digital |
| ASCII | American Standard Code for Information Interchange |
| Baud | Bits per second |
| D/A | Digital to Analog |
| high | TTL logic 1 (+5v) |
| I/O | Input and/or Output |
| IC | Integrated Circuit |
| IF | Intermediate Frequency |
| ISB | Intermediate Sideband |
| low | TTL logic 0 (0v) |
| LSB | Lower Sideband |
| TTL | Transistor Transistor Logic |
| USB | Upper Sideband |
| BFO | Beat Frequency Oscillator |

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I. INTRODUCTION

For many decades man has dreamed of the day when machines could relieve him of much of his work. In this era of computers and advanced technology, this dream is now becoming a reality. Connecting computers to other machines, however, is not just a simple matter of running a wire from one to the other. In order for the computer to be able to use its "thinking" ability, it must have some way to translate its signals into a form that is recognized by the machine it is controlling. This is where the interface becomes all important.

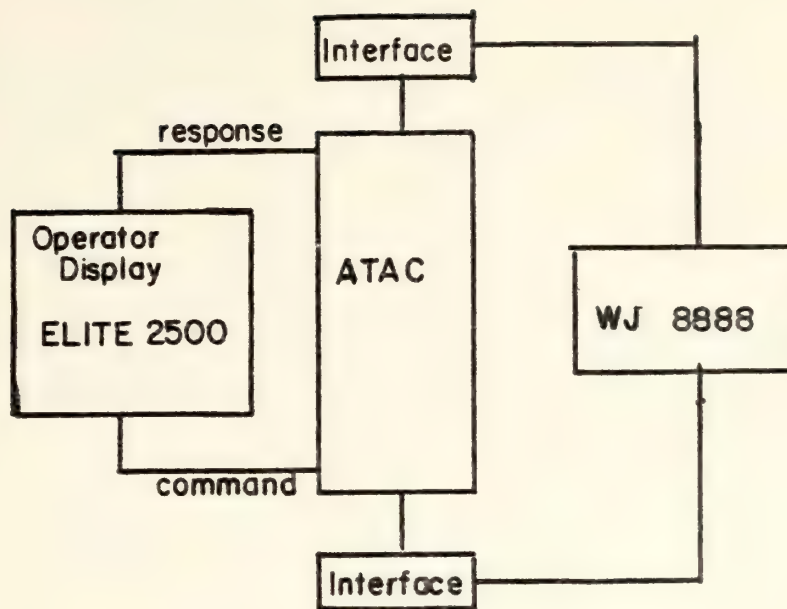
An interface is a piece of equipment placed in the data path between two devices. Its purpose is to rearrange, translate, or change the speed of this data to meet the needs of one or both devices. In other cases the interface is used to convert data from an analog to digital (A/D) or digital to analog (D/A) form, or both. Interfaces of either type range in complexity from a few integrated circuits to the use of microprocessors. Most, however, fall in between. This thesis discusses the design and construction of an interface in this middle class. Here, the computers are the Applied Technology Airborne Computer (ATAC) minicomputer and the MOS Technology Inc.'s KIM-1 microprocessor. Their goal is to program and process outputs from a digitally tunable Watkins Johnson WJ-8888.

The two computer systems arrive at their goal by

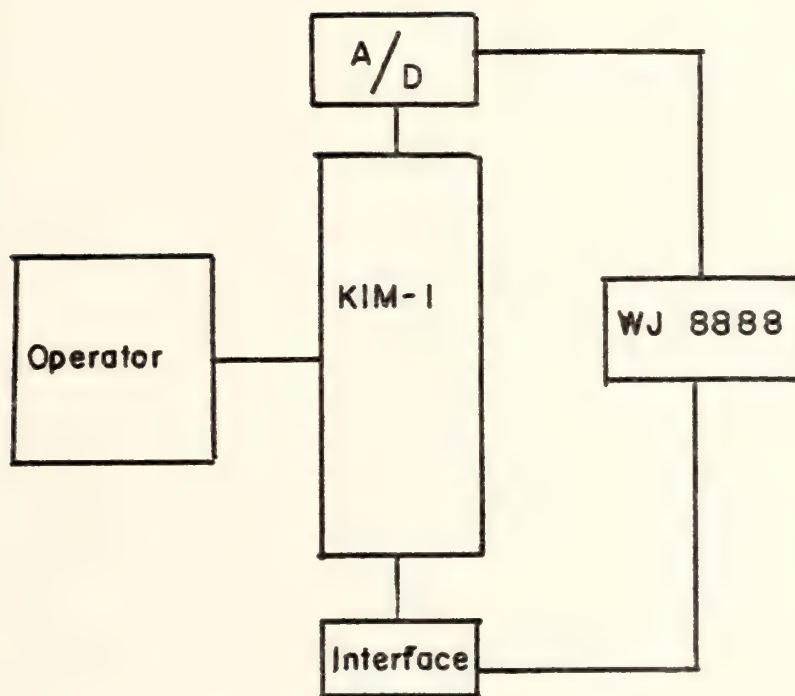
different means. The ATAC uses a closed loop with the operator (Figure 1a) while the KIM-1 excludes the operator while executing its program (Figure 1b). In the ATAC loop the operator actively controls all communication between the computer and receiver. In this way it is possible to display information from the receiver on the video display at any time except during a scan (see Chapter V). It also provides quick reference to the data to be sent, the data last sent, and latest received data. This was invaluable during debugging. From the terminal it is also possible to adjust available parameters as necessary to meet any requirement.

The KIM-1 does not directly exchange digital words with the receiver, but rather exchanges digital data for analog data. This does not provide a feedback loop that includes the operator. Once begun, the KIM-1 program selects and sends data words to the receiver and processes the analog data received until the program comes to an end or is halted by the operator. Direct information is not available to determine when or if a digital word has been sent or received correctly.

Problems encountered during the design and construction of the interface and their solutions are shown in Table I. In this instance signal level compatability was not a problem because the I/O from the receiver, the interface, and the two computers were all TTL logic levels and, therefore, matched. It is believed that these problems are a typical list that may be encountered when interfacing.



(a)



(b)

Figure 1
Computer Control

PROBLEM

SOLUTION

1. Noise on the ATAC I/O lines.

1. Use of Schottky circuits reduced or eliminated the noise.

2. Different clock rates of the computers and the receiver, and different data word lengths.

2. ATAC; converted parallel outputs into serial form. KIM-1; used interrupt lines to slave the KIM-1 to the receiver's clock.

3. Timing

3. Identified receiver periods by the Monitor Clock output. This provided a pulse which signaled stable data.

4. Inputting data to the ATAC.

4. Open collector buffers were used to sink the required current for proper data transfer.

5. Switching between the ATAC and the KIM-1.

5. Multiplexers and buffers were used to switch between the two computers.

Table I

Problems and Solutions

II. THE RECEIVER

The Watkins Johnson WJ-8888 (WJ) is an HF receiver designed for use in the 550 KHz to 30 MHz band. Its advantages include the ability to detect and output both the AM and FM IF signals while simultaneously maintaining a separate output of eight selectable detection modes. Options available to the operator include different IF bandwidths, variable RF gain, squelch control, and a tuneable BFO frequency. The WJ is digitally controlled and uses a 64-bit word as shown in Figure 2. This word contains the information necessary to transfer the frequency, detection mode, IF bandwidth, RF gain, BFO frequency, and signal strength both internally and externally.

All inputs and outputs from the receiver are controlled by the synchronous, remote I/O board. This board is a gated transfer point for all digital data exchanged with the receiver. A number of control lines are needed to provide the necessary demands on the receiver. Three balanced input pairs and four balanced output line pairs, plus a ground are provided for this purpose. All three inputs are required for remote operation. They are address (or enable), trigger, and data input. The address pair is the most important for it serves as the master "on-off" switch for the remainder of the I/O pairs. The outputs furnish the required clocks (command and monitor), output data, and a local/remote status.

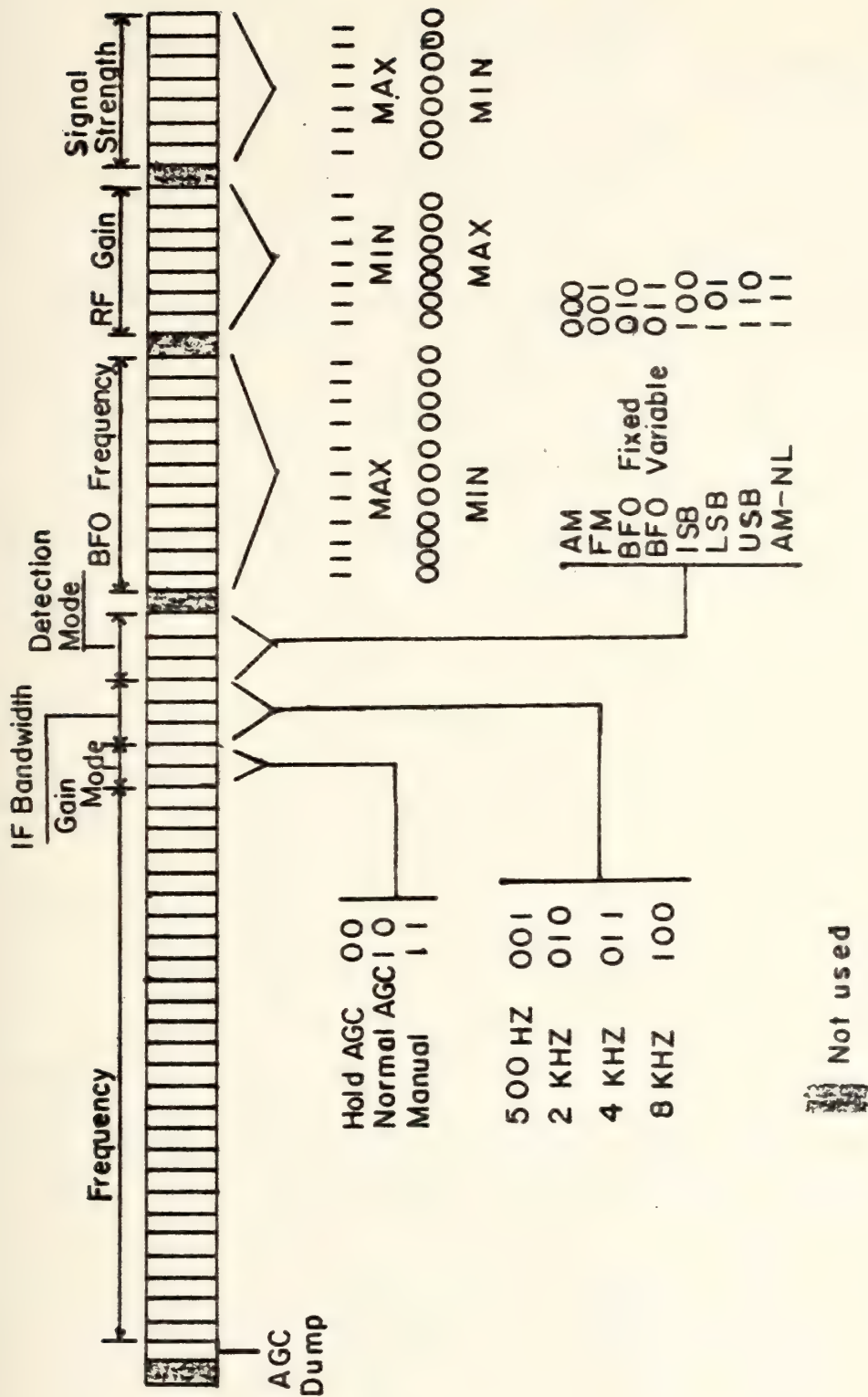


Figure 2
Receiver's Word

The Watkins Johnson operates on a sequential cycle divided into four equal periods and six identifiable modes. The periods regulate the different operations while the modes ascertain the origin of the data. Table II shows the interaction of the periods and modes of the receiver. Three of the six modes are memory read and write functions; these cannot be remotely controlled and, therefore, are of no concern here. Of the remaining three, two are the remote active and remote passive modes. These allow the introduction of externally generated data and prevent manual intervention during all but one of the four periods. Manual control is available in the remaining mode, local.

In order to manage the data word movement correctly, the receiver utilizes a common bus or data node arrangement as shown in Figure 3. This simplifies operation by forcing all data words to pass through this node in the same direction, regardless of their origin or desired destination. The multiplexer controls the input to the data node. Control of the multiplexer and, therefore, the origin of the data is managed by the internal modes of the receiver. The objective of period one is to load the receiver register. In the local and remote passive modes, the data word is shifted from the front panel register, through the multiplexer and data node, into the receiver register. The difference between these two modes is in the action of the data prior to shifting. The local mode updates the data word from the front panel storage registers during the early

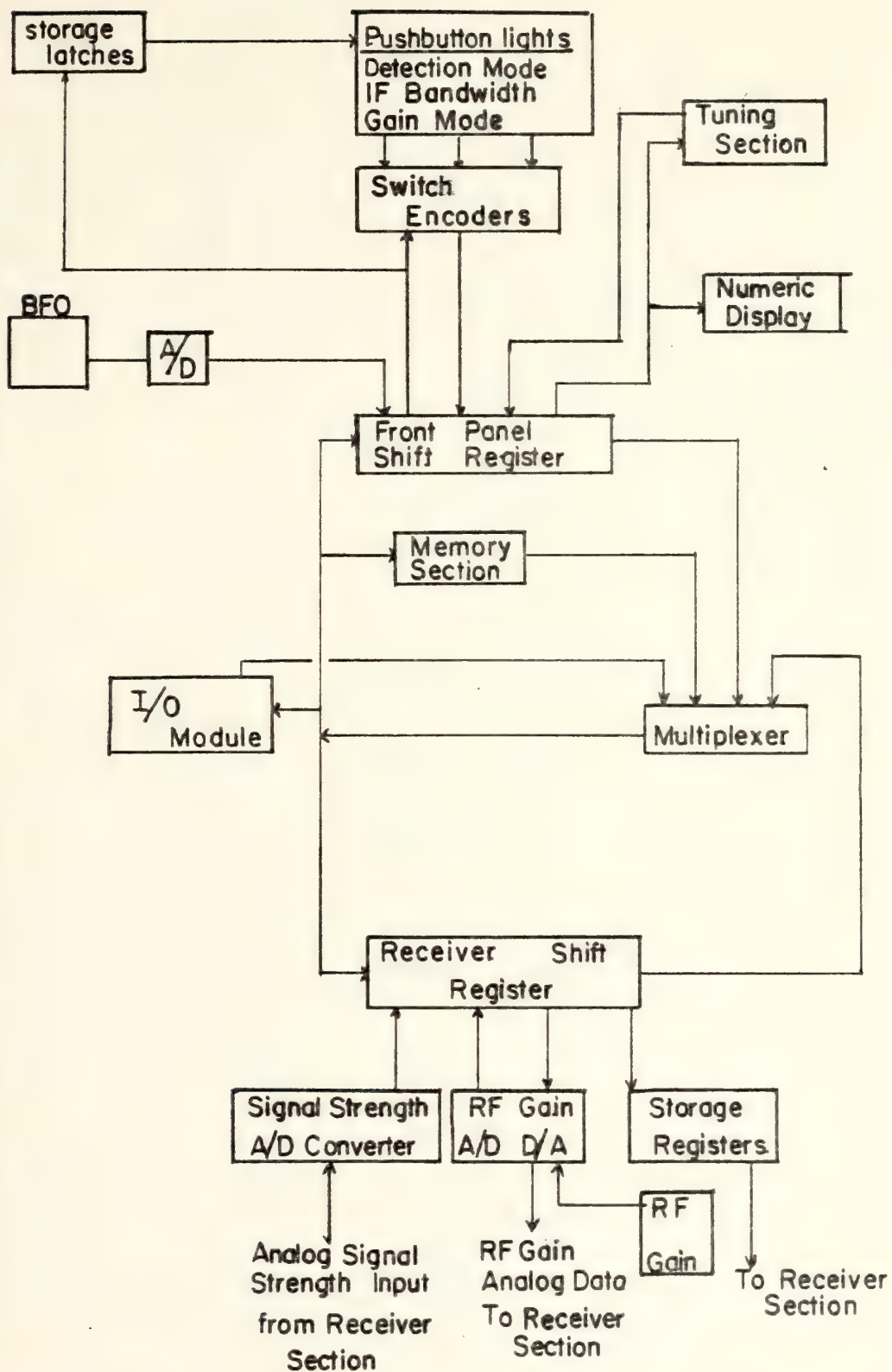


Figure 3
Block Diagram of the Digital Section

| Local | 1 | 2 | 3 | 4 |
|-------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------|
| | Load Front Panel Reg from Front Panel/word shifted to Receiver Register | Load Rcvr Storage Key/ Signal Strength and RF gain updated /word shifted to FrontPanel Register | Display updated no words shifted | Change to Remote Active or Remote Passive possible |
| Remote Passive | Word shifted from FrontPanel Register to Receiver | Update only Sig Str /Load Rcvr Storage Reg/word shifted to FrontPanel Reg. | Same as Local | Change to Lcl or Remote Active possible |
| Remote Active | Word shifted from I/O module to Receiver Register | Same as Remote Passive | Same as Local | Change to Remote Passive automatic. Change to Local possible |

Table II

Receiver Modes and Periods

portion of period one. This action is inhibited during the remote passive mode. In the remote active mode the data word originates from a remote device, is shifted by the command clock through the remote I/O board, on to the receiver register via the multiplexer and data node.

The first part of the second period is spent loading the data shifted during period one into the receiver storage registers. During this time the signal strength is updated in the receiver register regardless of the mode. The RF gain A/D-D/A converter functions according to the selected mode. In the local mode the RF gain bits in the data word are replaced by A/D conversion of the front panel RF gain control knob. The two remote modes reverse this action and load the RF gain D/A converter with this data from the word. After this is completed, the word is shifted in all modes out of the receiver register, through the multiplexer and data node, and into the front panel register. If the address line from the remote device is active high, the data word and the monitor clock are available on their respective output line pairs.

Periods three and four inhibit movement of the data word. Period three updates the front panel pushbutton lights and numeric display. Period four is the only period in which changes in receiver mode are allowed. During this period changes from a remote mode to local, or from local directly to remote passive can only be accomplished by depressing the appropriate pushbutton on the front panel. A

change from local and remote passive to remote active is automatically done by the remote I/O board whenever both the address and trigger line pairs are active high during this period. The remote active mode immediately reverts to the remote passive mode at the beginning of the next period four. The total cycle time of the receiver is 10.24 msec (2.56 msec per period). In order to change modes successfully, it may be necessary either to hold in the pushbutton or to hold the trigger and address lines high for up to 7.68 msec (three periods). This ensures that the mode change demand occurs in period four.

All outputs are available from connectors J1, and J6 through J10 located on the back of the receiver. J1 is the digital I/O connector. The other connectors are all analog outputs. J6 is a 455 KHz IF signal of at least 20 KHz bandwidth. AM and FM detector monitors are provided at connectors J7 and J9 respectively. J8 is a predetection, 455 KHz center frequency IF output whose bandwidth is set by the front panel. A balanced and unbalanced line audio and both upper and lower sideband outputs are available from the appropriate pins at J10. The balanced line operates at all times. The unbalanced line is operable unless headphones are plugged into the front panel. The lower sideband output is active when the receiver is in either ISB or LSB detection modes, and the upper sideband output is active during ISB, USB, and CW modes.

III. THE COMPUTERS

After studying the inputs and outputs from the receiver, three choices were available for further development of the interface. It could be designed to pass the clock pulses on to the interrupt lines of the computer and, therefore, match the computer's timing to that of the receiver. Or, a buffer could be constructed to input the data serially at the clock rate of the computer and output it at the clock rate of the receiver. The third choice, also a buffering arrangement, could exchange data in parallel to the computer and serially to the receiver.

The chief factor influencing the design decision was the availability and distribution of computer control and I/O lines. For the first computer, the primary objective was to investigate the feasibility of both remotely tuning the receiver and accepting a data word in return. The requirements for the second computer, the MOS Technology Inc. KIM-1, were less strict. Its objective was to tune the receiver digitally through use of the interface. Its input, however, was to come from a A/D converter for processing.

A. THE ATAC

The ATAC was originally designed to provide EW service to aircraft. Built to do real-time analysis of signals, it has very short cycle times, optional microcode programming, and double precision arithmetic as part of the standard package. All this, combined with its large instruction set, makes the ATAC a versatile and powerful tool. Although data could be transferred serially by proper programming, the ability of the ATAC to both input and output sixteen bits in parallel on the PIO (parallel input/output) lines proved more advantageous. Any one of the ATAC's sixteen registers can input or output from these lines. In order to properly transfer this data, the PIO bus must be augmented by an address provided by the sixteen bits of the "extended" Arithmetic Register (XAR). Another necessary output is one that informs the external device when the ATAC is ready for the transfer. On the ATAC this function is provided by the Input/Output Demand (IOD) line. Referring to the timing diagram in Figure 4, an input command is initiated by placing an address on the XAR lines and following this address with a low on the IOD. This signifies that the ATAC register is ready for data. After approximately one microsecond, the IOD is placed high and the address is removed. During this microsecond the data for the ATAC must be stable. For an output command, the XAR and the PIO lines first present the address and data for output. When they

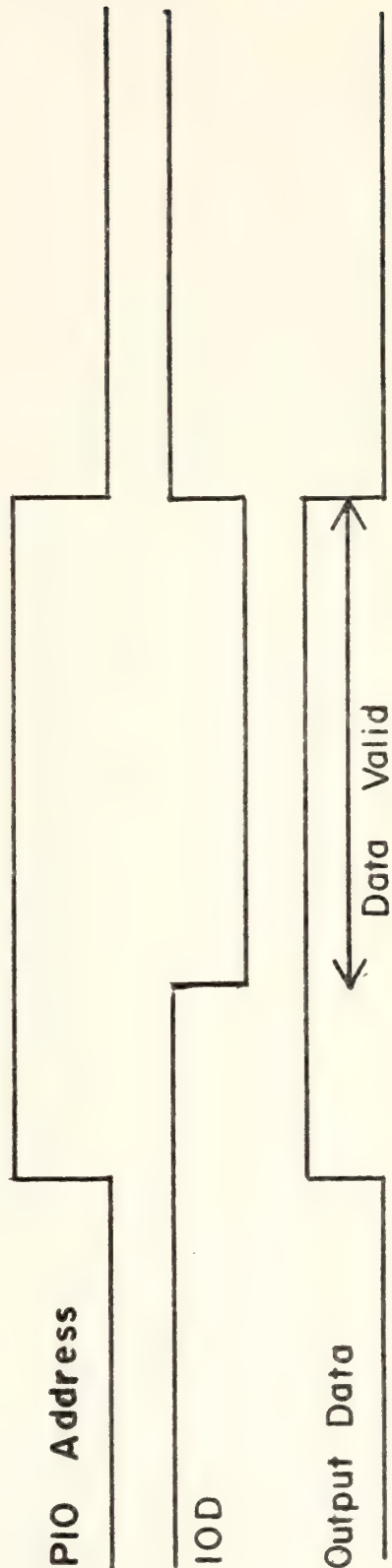
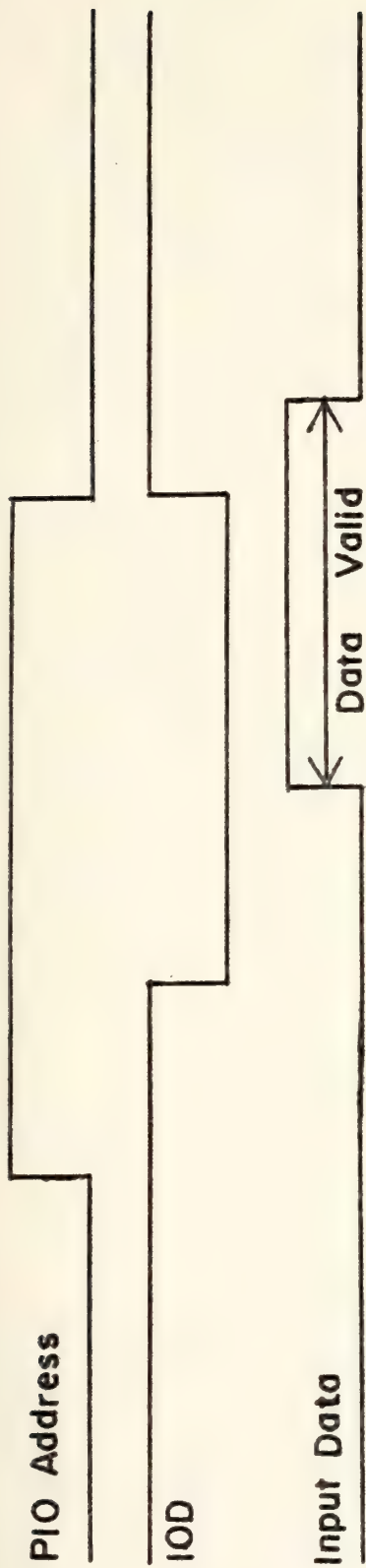


Figure 4
ATAC I/O Timing Diagram

are stable, the IOD line is set low. The data is then available for about a microsecond, as before. The IOD line is then placed high and the address and data are removed from their respective lines.

For operator interaction a serial ASCII, RS232 I/O port is also available. A Datamedia Elite 2500 television terminal is connected here to provide the operator with the necessary control and programming capability for use of the ATAC. By proper programming and use of the XAR lines, it was possible to translate each command for the interface. Using a demultiplexer on the interface board, four of the five available XAR addresses were separated into sixteen separate commands. One of the remaining lines and the IOD line were used as strobes to identify the receiver and to signify stable data (Chapter III). This arrangement provided both the adequate isolation and flexible operation desired.

B. THE KIM-1

The KIM-1 is at the other end of the computer spectrum with respect to the ATAC. It is a microprocessor designed around the MOS Technology Inc. series MCS6500 Central Processor Unit. Complete on a single printed circuit board, the KIM-1 is simple to operate and easy to program. While its cycle time is slower than that of the ATAC, it is still much faster than the receiver and more than adequate to meet

the requirements. Since the input data came from converted analog data supplied from the receiver's FM IF output (J9) and an external A/D converter, the design for this portion of the interface was simpler.¹

¹For a more detailed discussion of the KIM-1, its objectives, programs, and operating procedures, see Signal Acquisition and Sampling Using a Microprocessor, by LT. D. Rosenbender.

IV. THE INTERFACE

The interface was initially designed solely for the ATAC. A means of converting four ATAC words into one receiver word was needed first, in order to test the program, the computer, and the receiver together. The simplest and cheapest way to accomplish this conversion and still fully utilize the capabilities of the ATAC was to build a 64-bit register using eight parallel-in, serial-out, eight-bit shift registers. A control section was also necessary to properly handle this data. The ATAC XAR addresses were decoded by this control section to provide the load commands for the registers and to signal the receiver to input the word.

The next step in construction was also simple in theory. Since the computer uses the PIO lines for input as well as output, what was needed was a connection which would not interfere with the section already built. The ICs chosen to isolate the two sections are called Tri-State. These ICs have a "no output" state in addition to the normal high and low of TTL circuits. They could not, however, sink or supply enough current to drive the computer PIO bus. A solution was found by following these ICs with open collector buffers. Not only did they provide the necessary amplification, they did not degrade the isolation performance of the Tri-States. This second section also had

a 64-bit register built from the smaller shift registers. In this case, though, they were serial-in, parallel-out. In order to remove the word from the register in sixteen-bit sections, the outputs from the shift registers were connected to four-to-one multiplexers. These multiplexers were Tri-State. With the proper control it was possible to shift the word from the receiver into this register, and transfer it to the PIO bus in the correct sequence.

Increased complexity in the control section came with this implementation. A method was needed to prevent the computer from transferring a word until it had been completely shifted into the register. The period two clock output from the receiver was used as a reference to provide a pulse to inform the computer when shifting was complete. This pulse was positioned in the same time interval as period three of the receiver. The additional benefit of identifying period four was obtained. This meant that the output for the tridden line to the receiver could be shorter and still meet the requirement to occur in a portion of period four.

After completion of the testing for the ATAC, an interface was designed and constructed for the KIM-1. This design was very simple to implement, since all the necessary timing circuits were already built and tested. The two computers were kept from interferring with each other by installation of a manual switch. This switch controls the

address of a multiplexer that separates the lines in the interface common to both computers. The control section was wire-wrapped rather than placed on a printed circuit board to provide greater flexibility, easier maintenance, and to reduce cost.

A. THE CONTROL SECTION

The heart of the interface is the control section (Figures 5 and 6). The main purpose of this section is to decode and route commands from the ATAC and provide the necessary circuits to interface with the receiver. It also contains the circuits for the operation of the receiver by the KIM-1. The receiver's outputs are driven by line drivers which provide complementary TTL levels. The inputs are applied to line receivers which accept these complementary TTL levels. The interface, therefore, had to use these same receivers and drivers to be compatible with the Watkins Johnson.

The SPST switch mounted on the front of the interface case selects the computer controlling the receiver. With the switch in the ATAC position, a high is placed on pin 1 of IC-JJ and pins 1 and 10 of IC-MM. IC-JJ is now set up to transfer the following: the address and data outputs to the line drivers on IC-LL, the trigger command to pin 2 of IC-Z, and a low in line CCK7. The CCK7 line completes the

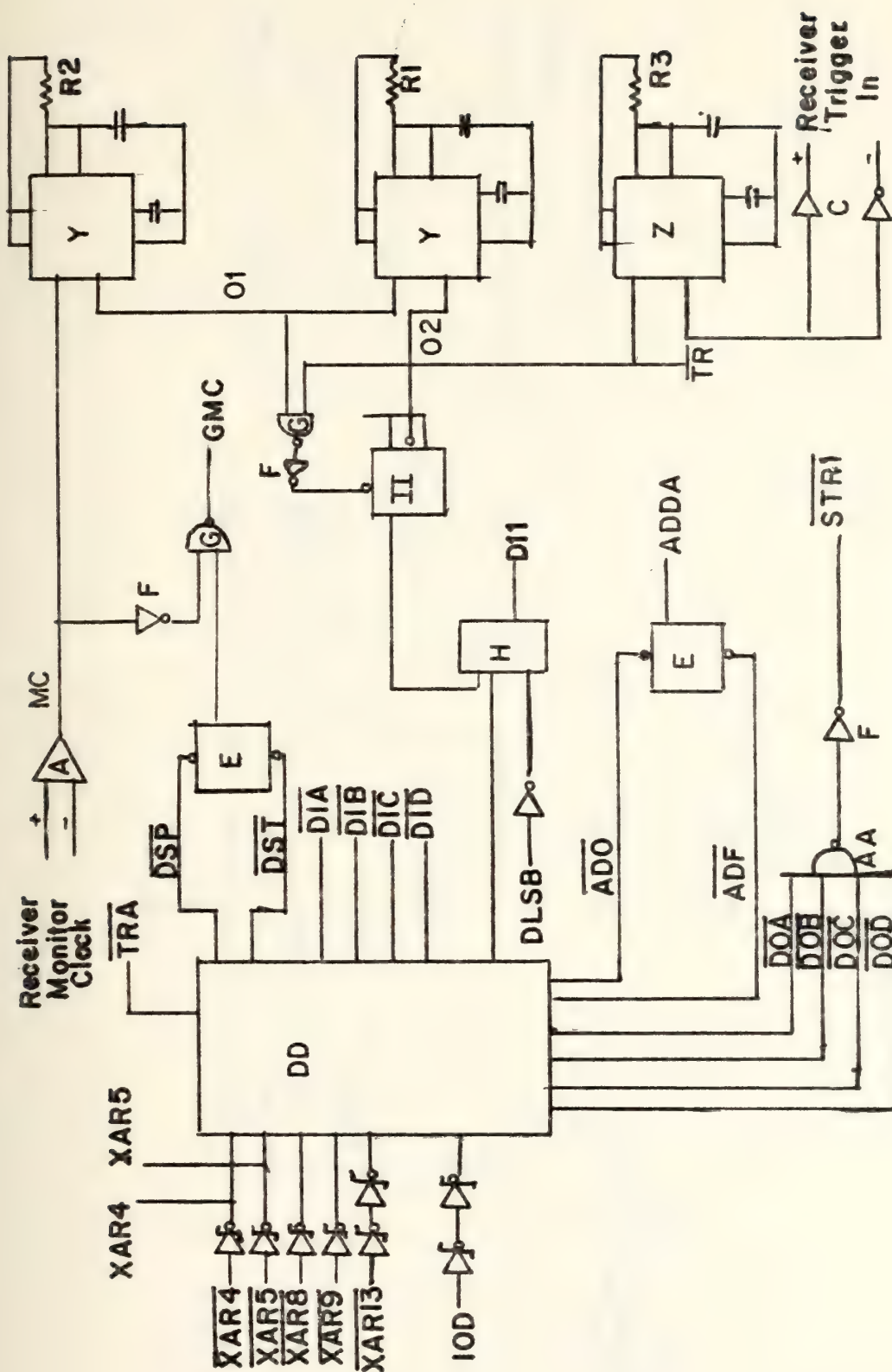


Figure 5
Interface Control Section (Part I)

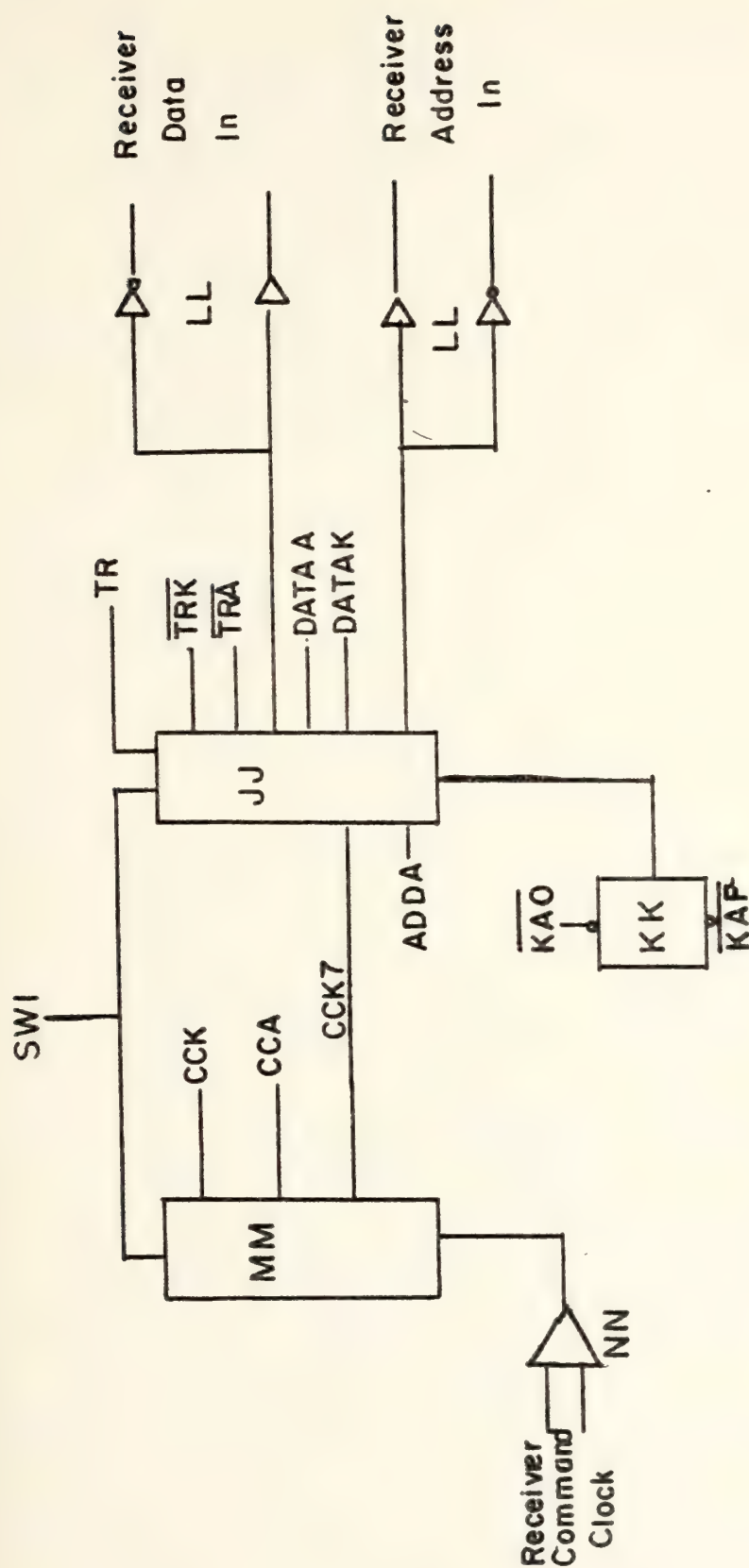


Figure 6
Interface Control Section (Part 2)

| | | |
|--------------------------------------------------|------|--------------------------------------|
| TRA | [0] | ATAC Trigger Command |
| DIA | [1] | Receiver input word one |
| DIB | [2] | Receiver input word two |
| DIC | [3] | Receiver input word three |
| DID | [4] | Receiver input word four |
| DSP | [5] | Stop Monitor Clock |
| DST | [6] | Start Monitor Clock |
| ADO | [7] | ATAC - Address on |
| DOA | [8] | Receiver output word one |
| DOB | [9] | Receiver output word two |
| DOR | [9] | Receiver output word two |
| DOC | [10] | Receiver output word three |
| DOD | [11] | Receiver output word four |
| RDY | [12] | Read D11 for ready signal |
| ADF | [15] | ATAC - Address off |
| TR | | Receiver trigger |
| CCK | | Kim-1 Command Clock |
| CCK7 | | Control Line for Kim-1 Command Clock |
| CCA | | Command Clock for ATAC interface |
| ADDA | | ATAC - Receiver Address |
| KADD | | KIM-1 - Receiver Address |
| KAO | | KIM-1 - Receiver Address On |
| KAF | | KIM-1 - Receiver Address Off |
| TRK | | KIM-1 Trigger Command |
| (Numbers in brackets refer to ATAC XAR commands) | | |

Table III
Interface Command List

commands to IC-MM. This IC is a quad Tri-State buffer which is used to control the destination of the command clock. The switch opens buffer one which directs the command clock to the ATAC. The CCK7 line closes buffers two and four disabling the command clock input to the KIM-1.

The ATAC supplies the control section with six lines. Five of these are the XAR bits 4,5,8,9, and 13. Using 4, 5, 8, and 9 as address lines to pins 20-23 of IC-DD, a four-to-sixteen demultiplexer, sixteen (2^4) unique commands (Table III) were made available. The sixth line, the IOD, and XAR 13 were used as strobes or enables for the demultiplexer. In this way XAR 13 was able to specify this receiver uniquely, and the IOD ensured that addresses and data were stable before passing a command. When both IOD and XAR 13 are low, IC-DD is operational and the output corresponding to the address on pins 20-23 is forced low. At any time that either or both the two strobe lines are high, all outputs of IC-DD are held high and no commands are generated, regardless of the activity on pins 20-23.

At the beginning of the Receiver Control program (Chapter IV), the ATAC sends commands to address the receiver (ADD) and to open the gate for the monitor clock (DST). ADD places a low on pin 2 of IC-E, setting the flip-flop and forcing the ADDA line high. This line activates the receiver's I/O through ICs -JJ, -A, -B, -C, and -LL, as described above. The DST command is passed to

pin 7 of IC-E. This sets this flip-flop and allows the monitor clock (MC) to shift data from the receiver into the storage register during every period two of the receiver's cycle. The MC line is also connected directly to a timing circuit. This circuit produces the pulse described in the early part of this chapter. The first of a pair of monostable multivibrators, IC-Y (Figure 5) is triggered by the first clock pulse of MC. IC-Y outputs a pulse, interval A of timing diagram (Figure 7), which triggers the second. The second's output, interval B, is connected to pin 1 of IC-II, a negative-edge triggered, J-K flip-flop. This IC is wired so that it is set on the output of the second multivibrator and reset by either the the output of the first multivibrator or the command TR. The output of this flip-flop, pin 15, is called the RLP. This line is multiplexed with the least significant bit of the output register and inverted by IC-H for use by the ATAC on line D11.

The RLP pulse is adjustable through variable resistors (trimmers) one and two. Trimmer one controls interval B and trimmer two interval A. In effect, trimmer two varies the position of the pulse and trimmer one its width. The placement and width are the key to proper operation of the interface. The pulse must remain in period three. Although some overlap into period four is allowable it is not desirable, and any overlap into period two could cause

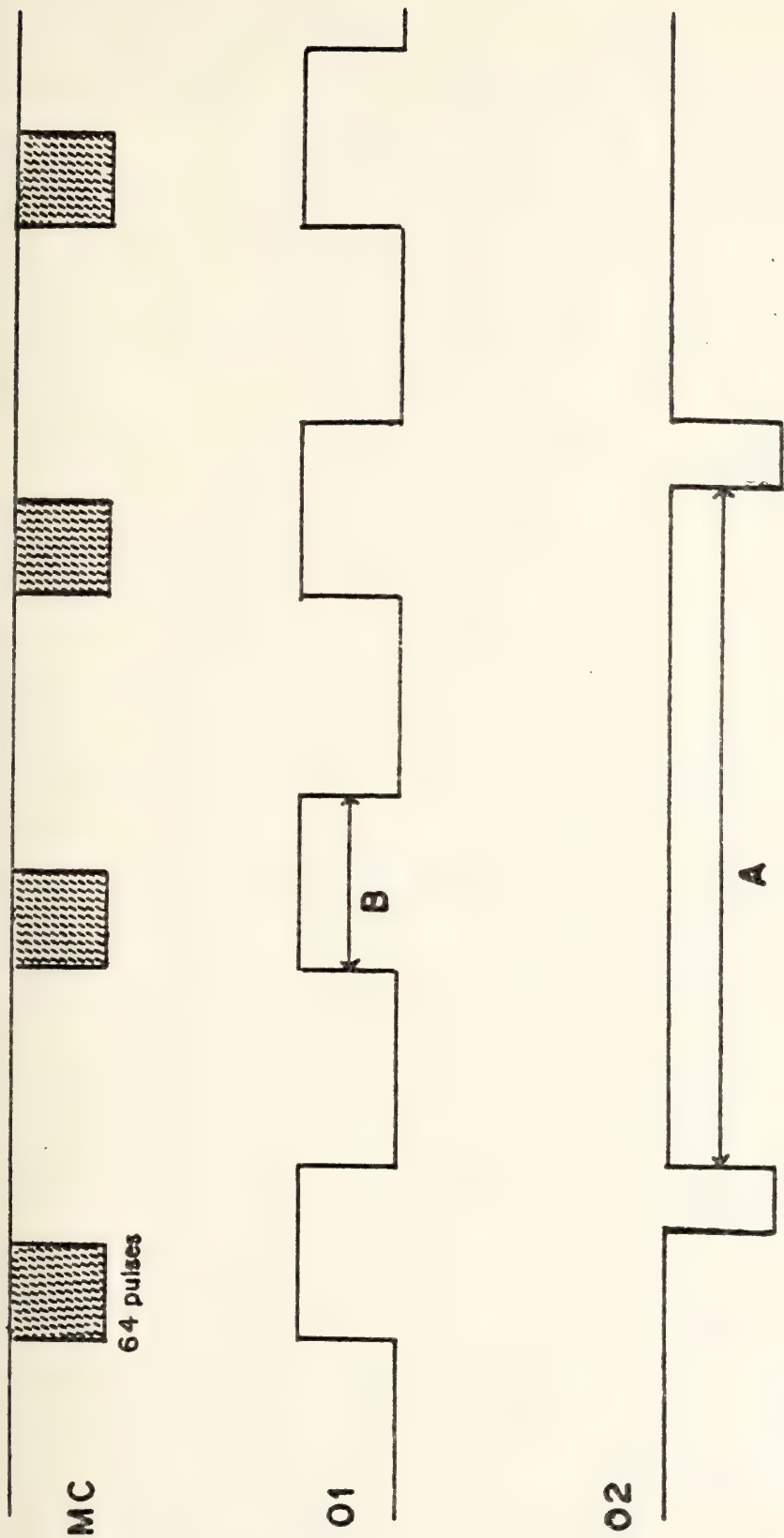


Figure 7
Interface Timing Diagram

incorrect operation. At present, the RLP pulse is programmed for every other period three. This allows the receiver to stabilize between samples taken by the computer. If more or less time is desired, the pulse can be set in every, every other, or every third period three by varying trimmer one. Greater time between pulses can be achieved by changing the .47 uF capacitor (HH-7,8) to one of larger value.

When the ATAC is ready to send a word, it loads the input register of the interface using commands DIA, DIB, DIC, DID, and then waits for a high on the D11 line. When RLP is low, D11 is high and the ATAC sends command TRA. This command is routed to a separate monostable multivibrator, IC-Z, by way of multiplexer IC-JJ. The timing circuit provides the trigger pulse in period four which changes the receiver's mode to remote active. It also sets RLP high to prevent any interaction with the ATAC until this cycle of the receiver is complete. During the following period one, the receiver sends the command clock to the input register via ICs -JJ and -MM, and inputs the data word through ICs -JJ and -LL. Meanwhile, the ATAC is waiting for RLP to go low again. When it does, the ATAC closes the MC gate with a DSP command and loads four sixteen-bit words with commands DDA, DDB, DDC, and DDD. Once the receiver word is stored in the ATAC, a DSIA command is sent to open the MC gate. When the operator has finished execution of the Receiver Control program and exits, the ATAC

sends the interface commands ADF and DSP to turn off the address line to the receiver and close the MC gate. The interface is now back in a stand-by status.

In order to set up the interface for operation with the KIM-1, the reset button must be pushed and the computer switch placed in the KIM-1 position. The reset button is unique to KIM-1 interface operation, and is necessary because of the use of the KIM-1's non-maskable interrupt. This interrupt is used to synchronize the KIM-1 with the receiver's command clock. Pressing the reset button places a momentary low on pin 3 of IC-KK, the flip-flop that controls the receiver's address line from the KIM-1. This resets the flip-flop and insures that the command clock output is disabled until required. ICs -JJ and -MM now transfer data from the KIM-1 and not the ATAC. The CCK7 line follows the address line from IC KK and gates the command clock off and on at the proper time. When the KIM-1 is ready to send a word to the receiver, it waits for a low on the RLP line. This line is connected to the maskable interrupt line. This low generates an interrupt and places the KIM-1 in the output program. This routine provides a trigger pulse for the trigger timing circuit and outputs the data synchronously with the command clock. The difference between the ATAC and KIM-1 actions of the interface is due to the position of the switch. The only function the interface serves is to provide reliable and compatible data to the appropriate device, whether it is receiver or

computer.

8. INPUT/OUTPUT REGISTERS

These two registers are used for the ATAC only. The registers were designated input or output by their related function with the receiver. They were constructed to provide the necessary, temporary storage while converting parallel and serial data back and forth. Both registers are connected to the PIO bus, with the major difference being the Tri-State connections of the serial to parallel, or output register.

The input register (Figure 8) was the easier to implement. It consists of eight 8-bit shift registers with parallel input and serial output. The parallel input comes from the ATAC's PIO bus, which is buffered by schottky inverters to reduce noise. The lines are connected to the ICs in such a way as to load words into two adjacent shift registers simultaneously. This is possible because the shift registers will only latch data in when their respective load line is low. By proper connection of the DIA-DID lines to pin 1 of the ICs, and coordinating the commands with the data, the output register can be completely and correctly filled. The command clock from the receiver is connected to pin 15 of each of the eight registers. When it is present, it clocks the data through the register exiting through pin 16 of IC-VV. From here, it goes through the control section

at IC-MM and on to the receiver.

The output register (Figure 9) performs the reverse operation. However, in order to separate it into words that are short enough for the ATAC, the data has to be multiplexed before it can be connected to the PIO bus. The Tri-State multiplexers, ICs -I through -L and -U through -X, and the required buffers, ICs -EE through -GG, were used to prevent interaction with the PIO bus when not in use. The timing here is more critical than in the input register system. Before the ATAC begins a read cycle from the output register, the clock signal to the register is stopped (DSP). This prevents the ATAC from reading non-stationary data. All the Tri-State multiplexers are addressed by connecting XAR bits 4 and 5 to pins 2 and 4 respectively. The commands DDA-DDD are ANDed together (NANDed and inverted) and the output connected to all the multiplexers as strobes at pins 1 and 15. When the ATAC reads a word, the XAR bits select the word and the strobe produces it during the microsecond when the PIO bus is available.

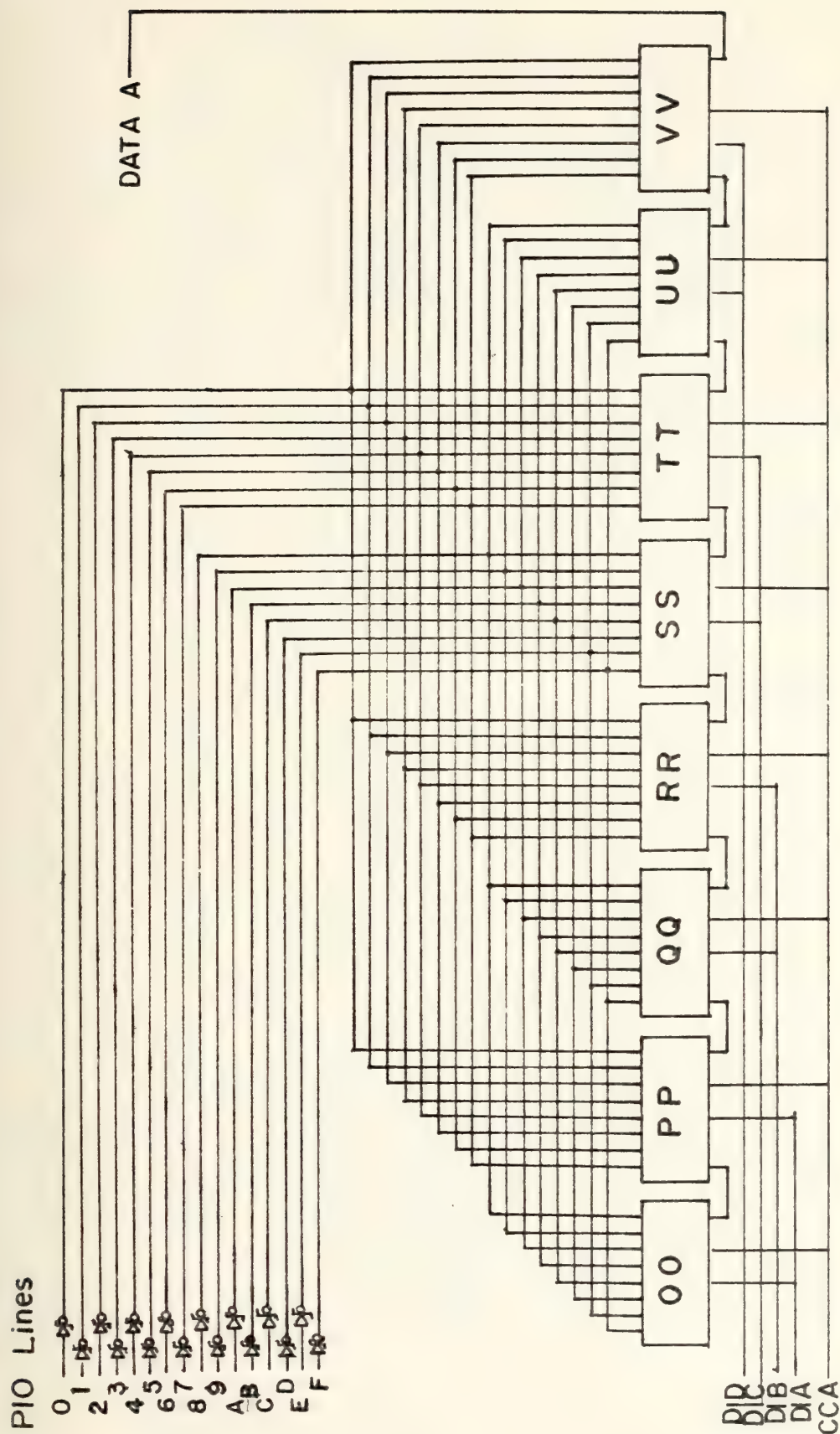


Figure 8
Input Register

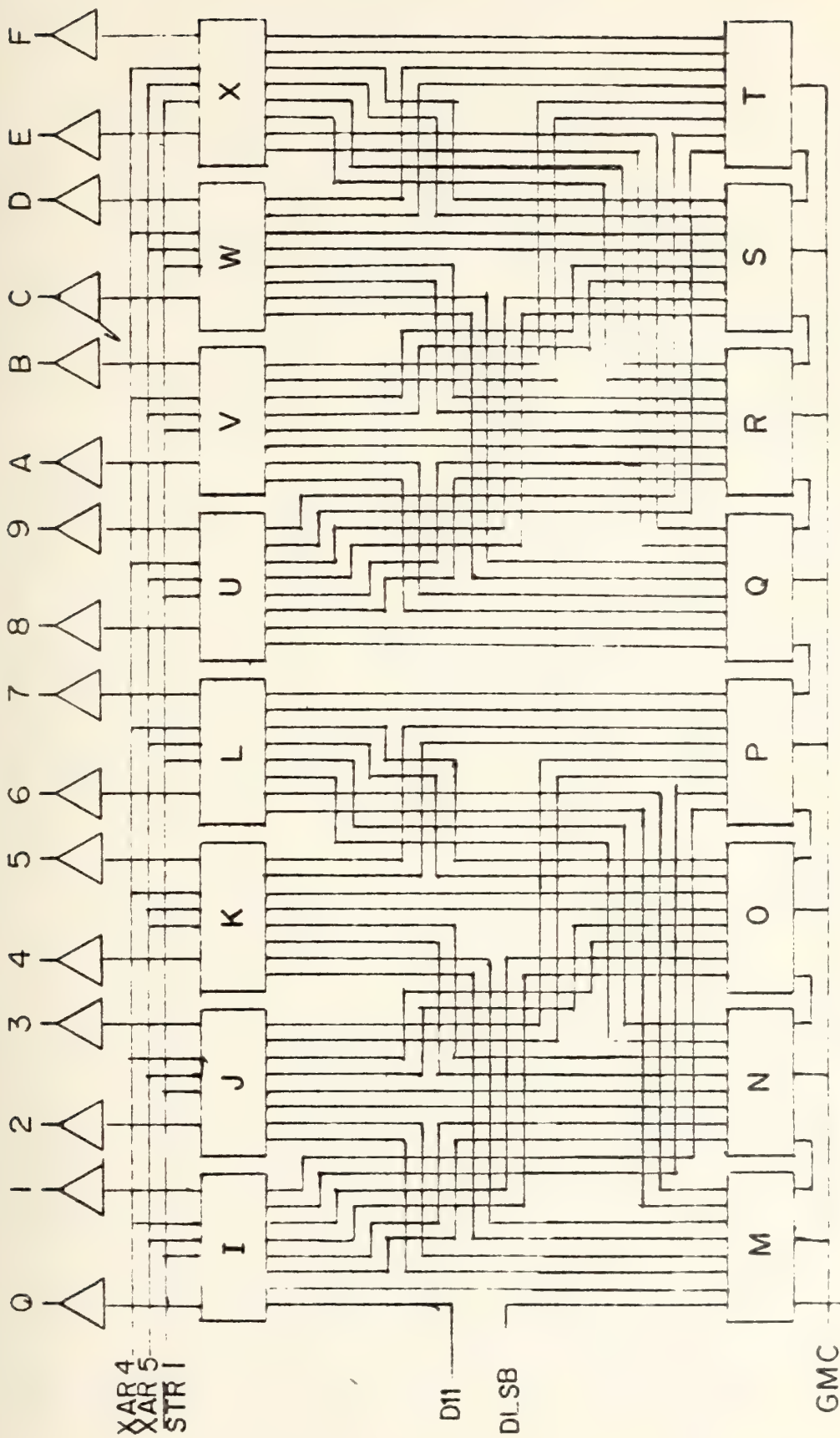


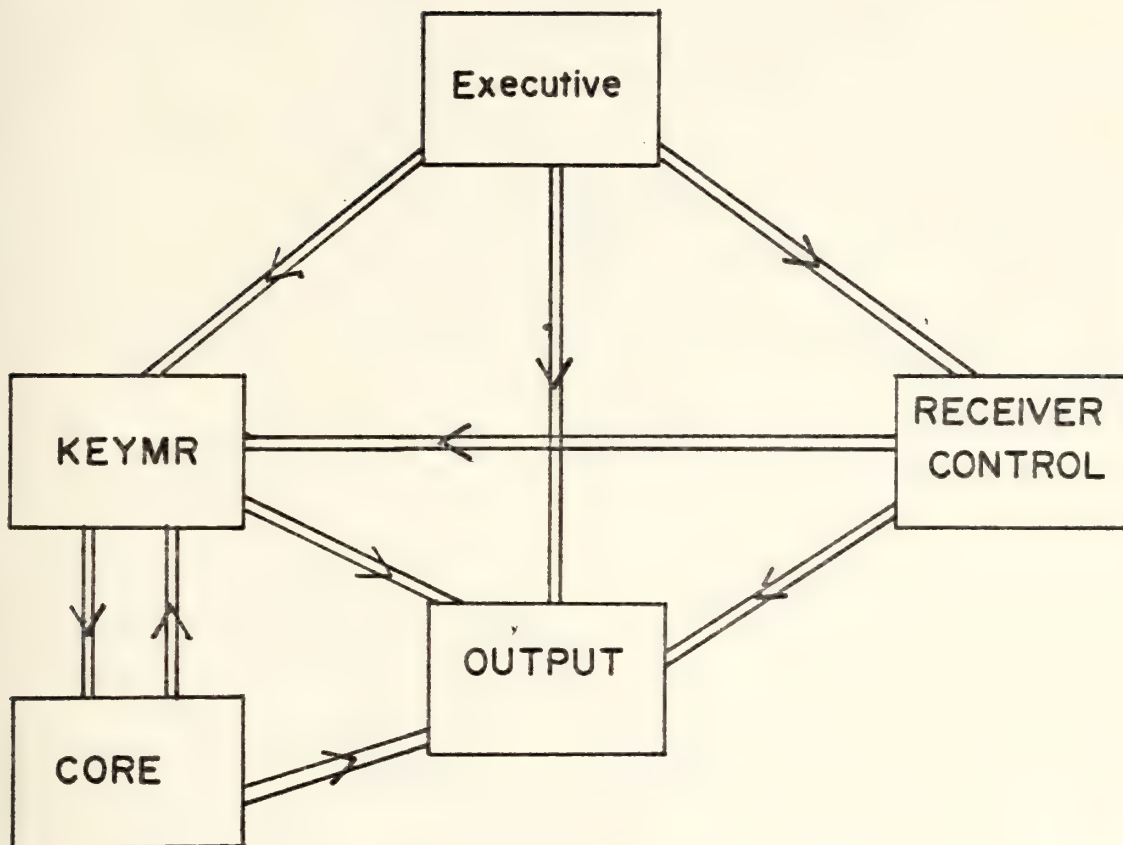
Figure 9
Output Register

V. THE PROGRAM

The ATAC program was written in two major sections; a system monitor and a control. The monitor is called the Main System and provides the operator the ability to program the ATAC from the operator's terminal. Receiver Control commands the interface and, therefore the receiver. Both programs were initially written prior to the construction of the interface, so many modifications were made using the Main System and its subroutines. After the interface was built and tested and the Receiver Control section modified to correctly control the tuning of the receiver, the complete program was saved on paper tape (Appendix C). Operation of the computer is discussed in Appendix B and a sample run can be found in Appendix F.

A. THE MAIN SYSTEM

The Main System section consists of a small executive and a group of interconnected subroutines (Figure 10). The executive provides a basis for the subroutines when the receiver control program is not being executed. It is these subroutines that control the input and output to the operator terminal. The input routine is called KEYMR and the output routine, OUTPUT. OUTPUT converts correctly-formatted computer words into ASCII and displays them on the




 ■ Subroutine Call

Figure 10
ATAC Program Block Diagram

I. CORE Commands

- CO -- calls CORE from KEYMR.
- a. DU 'address' -- displays 80 memory locations beginning with 'address'.
 - b. DI 'address' -- displays the contents of memory location 'address'.
 - c. CH 'address' 'value' -- Replaces the contents of memory at 'address' with 'value'.
 - d. CS 'address' -- Beginning at 'address', the contents of memory are replaced with the values typed on the lines following the command. Exit is accomplished by command DO.
 - e. DO -- Returns execution to CORE if in CS, otherwise returns to calling routine.

II. Receiver Control Commands

- WJ -- Calls Receiver Control from the executive.
- a. 0 -- Set-up - Routine to input values for entry into Receiver.
 - b. 1 -- Displays set-up control word.
 - c. 2 -- Displays last control word sent to receiver.
 - d. 3 -- Displays last control received from receiver.
 - e. 4 -- Sends set-up control word to receiver.
 - f. 5 -- Routine to input scan variables and execute a scan.
 - g. 6 -- Receive and Display control word from the receiver.
 - h. 7 -- Exit program and return to caller.
 - i. 8 -- Reinitialize program as if entering.

Table IV
AFAC Program Commands

terminal. KEYMR does the reverse, and stores the input in a buffer for use by the caller. KEYMR and OUTPUT were programmed to accept and display only uppercase letters, numerals, and a small number of needed symbols. But, because of the method employed to convert ASCII to machine code, it was found that each lower case letter entered from the keyboard was automatically mapped into its respective upper case twin. This relieves the operator of the responsibility of using the shift key. A part of the KEYMR, called CORE, is available for use by the operator to display and/or change sections of memory. The four available commands in this routine and their functions are displayed in Table IV. Care must be taken not to change memory locations which are used by the Main System. This could result in complete erasure of the ATAC's memory. Without KEYMR, OUTPUT, and CORE, or routines similar to them, it would have been extremely difficult to perform any amount of troubleshooting or modification of the Receiver Control section.

B. RECEIVER CONTROL

This section of the system is a branch of the executive. Its main objective is to control both outputs and inputs of the interface from the operator's terminal. To assist those operators with little experience in this system, the Receiver Control section is equipped with uncomplicated

instructions and program safeguards. This produces almost foolproof operation but, it does so at the expense of program simplicity. Discussion of this section is separated into two parts. First a broad description of the complete section is discussed, followed by a detailed look at the two subroutines which interact with the interface.

When the Receiver Control program is entered, it performs five important actions. It initializes all necessary flags; enables the receiver and opens the MC gate; sends and receives a complete receiver word; and displays the instruction set to the operator. After this, it calls on KEYMR and waits for a command. When an input is delivered, the program checks its legality. If it is not a valid command, KEYMR is called again.

A valid command is a numeral between zero and eight (Table IV). These can be separated for discussion into three groups. The display group (0-3) inputs and exchanges information with the operator. The receiver group (4-6) performs operations with the receiver. The final group of commands (7-8) are used to exit or reinitialize the program. Group one has one input and three display commands. Command zero instructs the operator to input the parameters desired. It stores these parameters in memory in the display format, as opposed to control word format. Commands one, two, and three all display parameters. One displays the last parameters set-up by command zero. Two displays the last parameters sent to the receiver. Three displays the last

word received from the receiver. Commands seven and eight make up group three. Seven exits the program entirely and returns to the executive after disabling the receiver. Eight, on the other hand, returns the program to its beginning as if it had just been entered.

The remaining three commands are the most important. Group two commands control the actions of the interface. Command four converts the parameters set-up by command zero into control word format. It then calls the I/O subroutine described below, and outputs and inputs a receiver word. To merely receive a word from the receiver, command six is used. The program calls the input subroutine below and then exits to command three to display the parameters received. Command five scans a band of frequencies selected by the operator in search of a specified signal strength. All other parameters remain the same as those set-up by command zero.

With the exception of the instructions executed when entering and exiting Receiver Control, complete control of the interface and the receiver is resident in approximately forty computer instructions. These forty are grouped into the two subroutines WJR and WJS. WJS sends words to the receiver and WJR receives them. WJS loads the information and addresses to be sent to the receiver into the computer registers. The addresses are then matched to a word of data and sent to the interface input register. The routine now waits for the appropriate signal generated by RLP. When

this is received, a trigger command is sent to load the word into the receiver. At this point the routine checks the value of a counter. This test is to prevent the computer entering an infinite loop if either the interface or receiver is not turned on. If the test is unsatisfactory, the routine prints:

INFINITE LOOP
PLEASE CHECK RECEIVER AND INTERFACE

and reverts to operator control. If the test is satisfactory, the subroutine automatically continues to WJR. WJR loads another set of addresses into the computer registers. Here, a short wait for the RLP signal is necessary before any action is taken. The MC gate is closed immediately upon receipt of this signal. The receiver word is then loaded into the ATAC by outputting the address on the XAR lines and reading the data on the PIO lines. When the complete word is received, the MC gate is opened. At this point it is necessary to test for command six. This test determines whether the computer is sending and receiving or only receiving. If the execution of both WJS and WJR is being performed, a comparison between the word sent and the word received is necessary. This comparison is skipped if the computer is only executing WJR (command six). The first three control words sent by WJS and received by WJR are used for this comparison, when it is performed. If

any words differ, the computer returns to WJS to repeat the cycle until one of two conditions are met: either the words match or the WJS counter test discussed earlier fails. If the words match, WJP continues on to convert the received control words into the display format and then returns to the caller.

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VI. RECOMMENDATIONS

The system as it stands now is but a beginning. Additions and modifications for future work should include; A/D converters for the receiver outputs; Morse and/or teletype decoders; and an expansion of the computer program. Implementation of either of the first two implies the third. There are some operator assistance program modifications that need to be made. The two that come immediately to mind are (1) a method to abort the scan routine from the operator's console, and (2) the ability to change individual parameters in addition to the set-up command already located in the program. Addition of the A/D converters implies a program increase to decode and process this new data. Switching routines and probably some hardware will be needed for the decoders. The capabilities of the system are limited only by the abilities of the operator and programmer.

VII. CONCLUSION

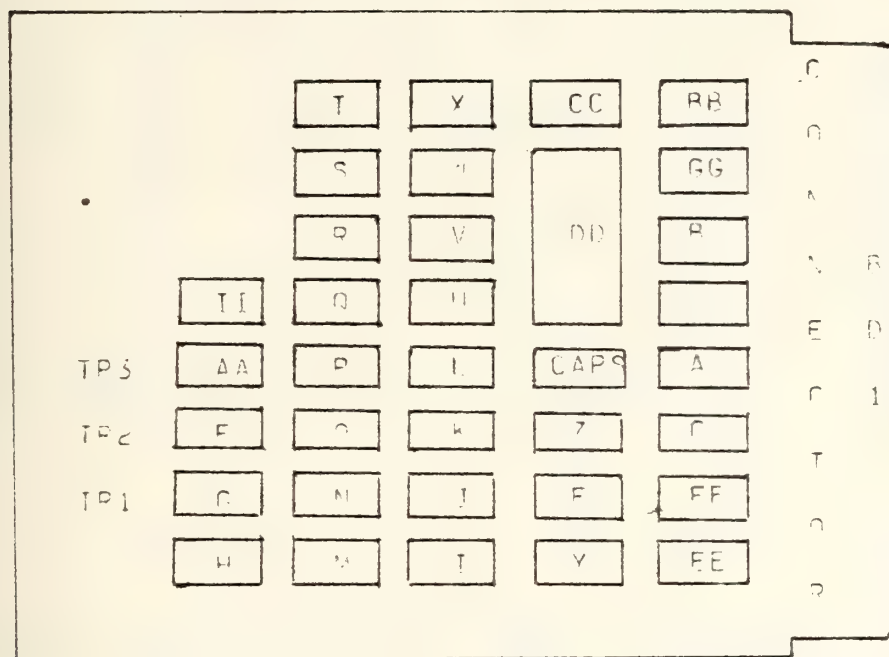
As long as the computer requires only that data obtained from the receiver's word, the interface is flexible enough to provide reliable results. At this time there are no known "bugs" in either the interface or the program. Both have been thoroughly tested to provide the operator with the most dependable system possible.

APPENDIX A

INTERFACE WIRING

A. Board 1

Integrated circuit locations (from Top of board).



Integrated Circuit

| pin | A | B | C | F | F | G | H |
|-----|---------|--------|---------|-------|---------|--------|--------|
| 1 | 8820 | 8820 | 8830 | 7476 | 7404 | 7400 | 74157 |
| 2 | BD1-M | BD1-K | C-2/Z-3 | VCC | M-3 | BD2-E | DD-14 |
| 3 | nc | nc | C-1/C-3 | DD-8 | H-3 | Y-9 | TI-14 |
| 4 | BD1-L | BD1-J | C-2/C-4 | DD-15 | A-6/Y-8 | F-11 | F-2 |
| 5 | nc | nc | C-3 | VCC | G-5 | E-11 | I-6 |
| 6 | nc | nc | BD1-F | VCC | AA-6 | F-4 | nc |
| 7 | F-3/Y-8 | M-1 | BD1-H | VCC | G-12 | F-9 | nc |
| 8 | GRD | GRD | GRD | DD-7 | GRD | GRD | GRD |
| 9 | nc | nc | nc | DD-6 | T-8 | nc | nc |
| 10 | nc | nc | nc | VCC | G-6 | nc | nc |
| 11 | nc | nc | nc | nc | II-3 | nc | nc |
| 12 | nc | nc | nc | G-4 | G-3 | F-13 | nc |
| 13 | nc | nc | nc | VCC | I-15 | F-6 | nc |
| 14 | nc | nc | nc | GRD | G-11 | DD-14 | GRD |
| 15 | VCC | VCC | VCC | nc | VCC | VCC | VCC |
| 16 | XXXXXX | XXXXXX | XXXXXX | BD1-Y | XXXXXX | XXXXXX | XXXXXX |
| 17 | XXXXXX | XXXXXX | XXXXXX | VCC | XXXXXX | XXXXXX | XXXXXX |

Integrated Circuit

| pin | I | J | K | L | M | N |
|-----|----------|----------|----------|----------|------------|------------|
| 1 | 7214 | 7214 | 7214 | 7214 | 74164 | 74164 |
| 2 | X-15 | I-15/J15 | J-15/K15 | K-15/L15 | B-6/M-2 | M-13/N-2 |
| 3 | DD22/J-2 | I-2/K-2 | J-2/L-2 | K-2/U-2 | M-1 | N-1 |
| 4 | S-3 | S-5 | S-10 | S-12 | F-1 | U-6 |
| 5 | Q-3 | Q-5 | Q-10 | Q-12 | T-10 | U-10 |
| 6 | Q-3 | Q-5 | Q-10 | Q-12 | J-6 | V-6 |
| 7 | H-4 | M-5 | M-10 | M-12 | J-10 | V-10 |
| 8 | EE-1 | FE-5 | EF-11 | FF-1 | GRD | GRD |
| 9 | GRD | GRD | GRD | GRD | N-8 | M-8/O-8 |
| 10 | EE-3 | FE-9 | EF-13 | FF-3 | VCC | VCC |
| 11 | M-4 | M-6 | M-11 | M-13 | K-6 | W-6 |
| 12 | Q-4 | Q-6 | Q-11 | Q-13 | K-10 | W-10 |
| 13 | Q-4 | Q-6 | Q-11 | Q-13 | L-6 | X-6 |
| 14 | S-4 | S-6 | S-11 | S-13 | L-10 | X-10 |
| 15 | DD23/J14 | K-14/I14 | J-14/L14 | K-14/U14 | VCC | VCC |
| 16 | F-12/J-1 | J-1/K-1 | K-1/L-1 | L-1/U-1 | XXXXXXXXXX | XXXXXXXXXX |
| 17 | VCC | VCC | VCC | VCC | XXXXXXXXXX | XXXXXXXXXX |

| pin | U | P | Q | R | S | T |
|-----|----------|----------|----------|----------|----------|----------|
| 1 | 74164 | 74164 | 74164 | 74164 | 74164 | 74164 |
| 2 | U-13/O-2 | O-13/P-2 | P-13/Q-2 | Q-13/R-2 | R-13/S-2 | S-13/T-2 |
| 3 | O-1 | P-1 | Q-1 | R-1 | S-1 | T-1 |
| 4 | J-5 | U-5 | T-4 | U-4 | I-3 | U-3 |
| 5 | I-11 | U-11 | T-12 | U-12 | I-13 | U-13 |
| 6 | J-5 | V-11 | J-4 | V-4 | J-3 | V-3 |
| 7 | J-11 | V-11 | J-12 | V-12 | J-13 | V-13 |
| 8 | GRD | GRD | GRD | GRD | GRD | GRD |
| 9 | N-8/P-8 | O-8/Q-8 | P-8/R-8 | Q-8/S-8 | R-8/T-8 | S-8/F-8 |
| 10 | VCC | VCC | VCC | VCC | VCC | VCC |
| 11 | K-5 | W-5 | K-4 | W-4 | K-3 | W-3 |
| 12 | K-11 | W-11 | K-12 | W-12 | K-13 | W-13 |
| 13 | L-5 | X-5 | L-4 | X-4 | L-3 | X-3 |
| 14 | L-11 | X-11 | L-12 | X-12 | L-13 | X-13 |
| 15 | VCC | VCC | VCC | VCC | VCC | VCC |

Integrated Circuit

| | U | V | W | X | Y | Z |
|-----|----------|----------|----------|----------|------------|------------|
| pin | 7214 | 7214 | 7214 | 7214 | 556 | 555 |
| 1 | L-15/U15 | U-15/V15 | V-15/W15 | W-15/X15 | Y2/Tp-1A | GRD |
| 2 | L-2/V-2 | U-2/W-2 | V-2/X-2 | W-2 | Y-1/HH-6 | PD1-E |
| 3 | T-3 | T-5 | T-10 | T-12 | HH-5 | C-1 |
| 4 | R-3 | R-5 | R-10 | R-12 | VCC | VCC |
| 5 | P-3 | P-5 | P-10 | P-12 | BD1C/II1 | HH-1 |
| 6 | N-3 | N-5 | N-10 | N-12 | Y-9 | HH-2/Z-7 |
| 7 | FF-5 | FF-11 | GG-1 | GG-5 | GRD | Z6/Tp-3A |
| 8 | GRD | GRD | GRD | GRD | A-6/F-3 | VCC |
| 9 | FF-9 | FF-13 | GG-3 | GG-9 | Y-6 | XXXXXXXXXX |
| 10 | N-4 | N-6 | N-11 | N-13 | VCC | XXXXXXXXXX |
| 11 | P-4 | P-6 | P-11 | P-13 | HH-4 | XXXXXXXXXX |
| 12 | R-4 | R-6 | R-11 | R-13 | Y-13/HH4 | XXXXXXXXXX |
| 13 | T-4 | T-6 | T-11 | T-13 | Y12/Tp-2A | XXXXXXXXXX |
| 14 | L-14/V14 | U-14/W14 | V-14/X14 | W-14 | VCC | XXXXXXXXXX |
| 15 | U-1/V-1 | V-1/W-1 | W-1/X-1 | X-1/I-1 | XXXXXXXXXX | XXXXXXXXXX |
| 16 | VCC | VCC | VCC | VCC | XXXXXXXXXX | XXXXXXXXXX |

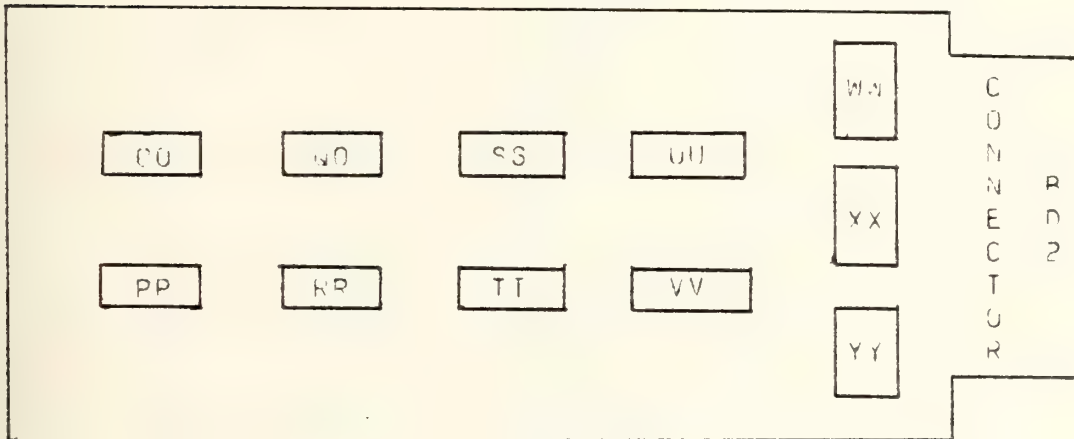
| | AA | BB | CC | EE | FF | GG | HH | II |
|-----|----------|----------|----------|----------|----------|----------|----------|------|
| pin | 7420 | 74s04 | 74s04 | 7407 | 7407 | 7407 | CAPS | 7476 |
| 1 | DD-10 | CC-6 | BD1-17 | T-7 | L-7 | W-7 | Z-5 | Y-5 |
| 2 | DD-11 | DD-18 | DD-23 | BD1-1 | BD1-7 | PD1-13 | Z-6 | VCC |
| 3 | nc | BD1-21 | nc | I-9 | L-9 | W-9 | Y-11 | F-10 |
| 4 | DD-9 | BB-5 | nc | BD1-2 | BD1-8 | BD1-14 | Y-12 | VCC |
| 5 | DD-13 | BB-4 | BD1-T | J-7 | U-7 | X-7 | Y-3 | nc |
| 6 | F-5 | DD-19 | BB-1 | BD1-3 | BD1-9 | BD1-15 | nc | nc |
| 7 | GRD | GRD | GRD | GRD | GRD | GRD | Y-2 | nc |
| 8 | nc | DD-20 | nc | BD1-4 | BD1-10 | BD1-16 | GRD | nc |
| 9 | nc | BD1-20 | nc | J-9 | U-9 | X-9 | GRD | nc |
| 10 | nc | DD-21 | nc | BD1-5 | BD1-11 | nc | GRD | nc |
| 11 | nc | BD1-19 | nc | K-7 | V-7 | nc | GRD | nc |
| 12 | nc | DD-22 | nc | BD1-6 | BD1-12 | nc | GRD | nc |
| 13 | nc | BD1-18 | nc | K-9 | V-9 | nc | GRD | GRD |
| 14 | VCC | VCC | VCC | VCC | VCC | VCC | GRD | H-2 |
| 15 | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | nc |
| 16 | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | GRD |

Integrated Circuit

| | | DD | |
|-----|-------|-------|-----------|
| | | 74154 | |
| pin | | pin | |
| 1 | RD1-P | 13 | AA-5 |
| 2 | RD1-X | 14 | G-13/H-1 |
| 3 | RD1-W | 15 | nc |
| 4 | RD1-V | 16 | nc |
| 5 | RD1-U | 17 | F-3 |
| 6 | E-8 | 18 | BR-2 |
| 7 | E-7 | 19 | BR-6 |
| 8 | E-2 | 20 | BR-8 |
| 9 | AA-4 | 21 | BR-10 |
| 10 | AA-1 | 22 | BR-12/I-2 |
| 11 | AA-2 | 23 | CC-2/I-14 |
| 12 | GRD | 24 | VCC |

II. Board 2

Integrated Circuit locations (from Top of board)



Integrated Circuit

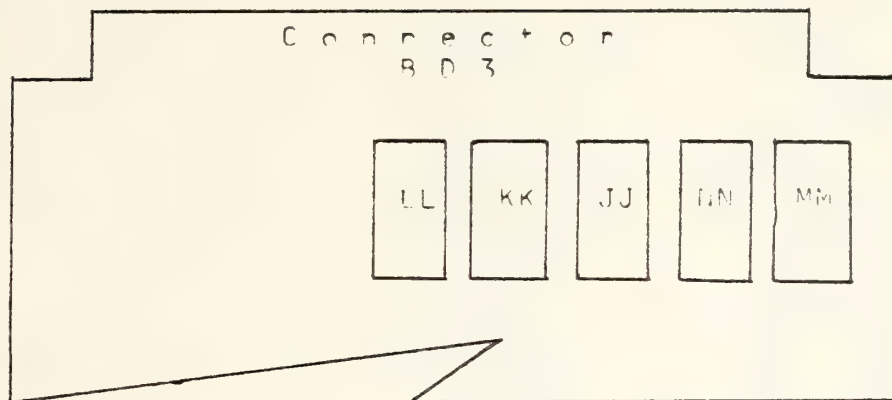
| | QQ | PP | QQ | RR | SS | TT |
|-----|--------|--------|--------|--------|--------|--------|
| pin | 74165 | 74165 | 74165 | 74165 | 74165 | 74165 |
| 1 | BD2-A | BD2-A | BD2-B | BD2-B | BD2-C | BD2-C |
| 2 | GRD | GRD | GRD | GRD | GRD | GRD |
| 3 | WW-2 | YY-6 | WW-2 | YY-6 | WW-2 | YY-6 |
| 4 | WW-12 | YY-4 | WW-12 | YY-4 | WW-12 | YY-4 |
| 5 | WW-4 | YY-2 | WW-4 | YY-2 | WW-4 | YY-2 |
| 6 | WW-10 | YY-10 | WW-10 | YY-10 | WW-10 | YY-10 |
| 7 | nc | nc | nc | nc | nc | nc |
| 8 | GRD | GRD | GRD | GRD | GRD | GRD |
| 9 | PP-10 | QQ-10 | PP-10 | SS-10 | TT-10 | UU-10 |
| 10 | VCC | QQ-9 | PP-9 | QQ-9 | RR-9 | SS-9 |
| 11 | XX-2 | XX-4 | XX-2 | XX-4 | XX-2 | XX-4 |
| 12 | XX-12 | XX-6 | XX-12 | XX-6 | XX-12 | XX-6 |
| 13 | WW-8 | XX-8 | WW-8 | XX-8 | WW-8 | XX-8 |
| 14 | WW-6 | YY-12 | WW-6 | YY-12 | WW-6 | YY-12 |
| 15 | BD2-21 | BD2-21 | BD2-21 | BD2-21 | BD2-21 | BD2-21 |
| 16 | VCC | VCC | VCC | VCC | VCC | VCC |

| | UU | VV | WW | XX | YY |
|-----|--------|--------|------------|------------|------------|
| pin | 74165 | 74165 | 74s04 | 74s04 | 74s04 |
| 1 | BD2-D | BD2-D | BD2-17 | BD2-10 | BD2-4 |
| 2 | GRD | GRD | QQ-3 * | QQ-11 * | PP-5 * |
| 3 | WW-2 | YY-6 | BD2-15 | BD2-9 | BD2-3 |
| 4 | WW-12 | YY-4 | QQ-5 * | PP-11 * | PP-4 * |
| 5 | WW-4 | YY-2 | BD2-13 | BD2-8 | BD2-2 |
| 6 | WW-10 | YY-10 | QQ-14 * | PP-12 * | PP-3 * |
| 7 | nc | nc | GRD | GRD | GRD |
| 8 | GRD | GRD | QQ-13 * | PP-13 * | nc |
| 9 | VV-10 | BD2-K | BD2-12 | BD2-7 | nc |
| 10 | TT-9 | UU-9 | QQ-6 * | nc | PP-6 * |
| 11 | XX-2 | XX-4 | BD3-14 | nc | BD2-5 |
| 12 | XX-12 | XX-6 | QQ-4 * | QQ-12 * | PP-14 * |
| 13 | WW-8 | XX-8 | BD2-16 | BD2-11 | BD2-6 |
| 14 | WW-6 | YY-12 | VCC | VCC | VCC |
| 15 | BD2-21 | BD2-21 | XXXXXXXXXX | XXXXXXXXXX | XXXXXXXXXX |
| 16 | VCC | VCC | XXXXXXXXXX | XXXXXXXXXX | XXXXXXXXXX |

* - bus connection - only first connection shown

C. Board Three

Integrated circuit locations (from Top of board)



Integrated Circuit

| | JJ | KK | LL | NN | NN |
|-----|-----------|-----------|------------|------------|------------|
| pin | 74157 | 7476 | 8830 | 74126 | 8820 |
| 1 | BD3-1 | VCC | LL-2/JJ-7 | BD3-1 | BD3-5 |
| 2 | KK-15 | BD3-11 | LL-1/LL-3 | BD3-17 | nc |
| 3 | BD3-6 | BD3-12/20 | LL-2/LL-4 | BD3-16 | BD3-4 |
| 4 | LL-10 | nc | LL-3 | JJ-12 | nc |
| 5 | BD3-8 | VCC | BD3-7 | GRD | nc |
| 6 | BD3-9 | nc | BD3-10 | BD3-16 | MM-a |
| 7 | LL-1 | nc | GRD | GRD | GRD |
| 8 | GRD | nc | BD3-19 | BD3-2 | nc |
| 9 | BD3-13 | nc | BD3-18 | NN-8 | nc |
| 10 | BD3-14 | nc | LL11/JJ-4 | BD3-1 | nc |
| 11 | nc | nc | LL12/LL10 | BD3-3 | nc |
| 12 | MM13/MM-4 | nc | LL13/LL11 | MM-a | nc |
| 13 | GRD | GRD | LL-12 | JJ-12 | nc |
| 14 | KK-15 | nc | VCC | VCC | VCC |
| 15 | GRD | JJ-2/JJ14 | XXXXXXXXXX | XXXXXXXXXX | XXXXXXXXXX |
| 16 | VCC | nc | XXXXXXXXXX | XXXXXXXXXX | XXXXXXXXXX |

D. Connectors

Circuit Board Edge-connectors

| | RD1 | RD2 | RD3 |
|----|-------------------|--------------|----------------|
| 1 | EE-2/RD2-10/CN1-2 | GRD | SW1/JJ-1/MM-10 |
| 2 | EE-4/RD2-11/CN1-3 | YY-5/RD1-13 | MM-8/RD2-21 |
| 3 | EE-6/RD2-12/CN1-4 | YY-3/RD1-14 | MM-11/CN3-1 |
| 4 | EE-8/RD2-13/CN1-5 | YY-1/RD1-15 | NN-2/CN2-2 |
| 5 | EE10/RD2-17/CN1-6 | YY-11/RD1-16 | NN-1/CN2-3 |
| 6 | EE12/RD2-16/CN1-7 | YY-13/RD1-12 | JJ-3/RD1-Y |
| 7 | FF-2/RD2-15/CN1-8 | XX-9/RD1-11 | LL-5/CN2-10 |
| *8 | FF-4/RD2-14/CN1-9 | XX-5/RD1-10 | JJ-5/CN3-2 |
| 9 | FF-6/RD2-9/CN1-10 | XX-3/RD1-8 | JJ-6/RD2-K |
| 10 | FF-8/RD2-8/CN1-11 | XX-1/RD1-1 | LL-6/CN2-11 |
| 11 | FF10/RD2-7/CN1-12 | XX-13/RD1-2 | KK-2/CN3-3 |
| 12 | FF12/RD2-6/CN1-13 | WW-9/RD1-3 | KK-3/CN3-4 |
| 13 | GG-2/RD2-2/CN1-25 | XX-5/RD1-4 | JJ-9/RD1-F |
| 14 | GG-4/RD2-3/CN1-24 | YY-11/RD1-8 | JJ-10/RD1-P |
| 15 | GG-6/RD2-1/CN1-23 | XX-3/RD1-7 | JJ-11/CN3-5 |
| 16 | GG-8/RD2-5/CN1-22 | WW-13/RD1-6 | nc |
| 17 | CC-1/CN1-11 | WW-1/RD1-5 | nc |
| 18 | BB-13/CN1-17 | nc | LL-9/CN2-12 |
| 19 | BB-11/CN1-19 | nc | LL-8/CN2-11 |
| 20 | BB-9/CN1-18 | nc | KK-3/RESET |
| 21 | BB-3/CN1-20 | DD-15/RD3-2 | nc |
| 22 | nc | GRD | VCC |
| A | GRD | DD-1/RD1-X | GRD |
| B | nc | QQ-1/RD1-W | nc |
| C | II-14/CN3-6 | SS-1/RD1-V | nc |
| D | nc | UU-1/RD1-U | nc |
| E | Z-2/RD3-13 | nc | nc |
| F | C-5/CN2-9 | nc | nc |
| H | C-6/CN2-8 | nc | nc |
| J | B-3/CN2-7 | nc | nc |
| K | B-1/CN2-6 | nc | nc |
| L | A-3/CN2-5 | nc | nc |
| M | A-1/CN2-4 | nc | nc |
| N | nc | nc | nc |
| P | DD-1/RD3-14 | nc | nc |
| R | nc | nc | nc |
| S | nc | nc | nc |
| T | CC-5/CN1-14 | nc | nc |
| U | DD-5/RD2-D | nc | nc |
| V | DD-4/RD2-C | nc | nc |
| W | DD-3/RD2-B | nc | nc |
| X | DD-2/RD2-A | nc | nc |
| Y | E-15/RD3-6 | nc | nc |
| Z | VCC | nc | nc |

Cabinet Connectors

| pin: | CN1 | CN2 | CN3 |
|------|-----------------|----------------|----------------|
| 1 | GRD | GRD | BD3-3 "CCK" |
| 2 | BD1-1 "PIO 0" | BD3-4 "CC - " | BD3-8 "DATA K" |
| 3 | BD1-2 "PIO 1" | BD3-5 "CC + " | BD3-11 "KAO" |
| 4 | BD1-3 "PIO 2" | BD1-M "MC - " | BD3-12 "KAF" |
| 5 | BD1-4 "PIO 3" | BD1-L "MC + " | BD3-15 "TRK" |
| 6 | BD1-5 "PIO 4" | BD1-K "DO - " | BD1-3 "PLD" |
| 7 | BD1-6 "PIO 5" | BD1-J "DO + " | nc |
| 8 | BD1-7 "PIO 6" | BD1-H "TR - " | nc |
| 9 | BD1-8 "PIO 7" | BD1-F "TR + " | nc |
| 10 | BD1-9 "PIO 8" | BD3-7 "DT - " | nc |
| 11 | BD1-10 "PIO 9" | BD3-10 "DT + " | nc |
| 12 | BD1-11 "PIO 10" | BD3-19 "AD - " | nc |
| 13 | BD1-12 "PIO 11" | BD3-18 "AD + " | nc |
| 14 | BD1-T "IOD" | nc | GRD |
| 15 | nc | nc | nc |
| 16 | BD1-17 "XAR 4" | nc | nc |
| 17 | BD1-18 "XAR 5" | nc | nc |
| 18 | BD1-20 "XAR 9" | nc | nc |
| 19 | BD1-19 "XAR 8" | nc | nc |
| 20 | BD1-21 "XAR 13" | nc | nc |
| 21 | nc | nc | nc |
| 22 | BD1-16 "PIO-15" | nc | nc |
| 23 | BD1-15 "PIO-14" | nc | nc |
| 24 | BD1-14 "PIO-13" | nc | nc |
| 25 | BD1-13 "PIO-12" | nc | nc |

E. Discrete Components

Capacitors

| | |
|--------|------------|
| .01 uF | HH-1/HH-14 |
| .2 uF | HH-2/HH-13 |
| .20 uF | HH-3/HH-12 |
| .01 uF | HH-4/HH-11 |
| .01 uF | HH-5/HH-10 |
| .47 uF | HH-7/HH-8 |

Resistors

| Trimmer | | | |
|---------|-----|------|-----|
| | 1 | 2 | 3 |
| A | Y-1 | Y-13 | Z-7 |
| B | VCC | VCC | VCC |
| C | VCC | VCC | VCC |

APPENDIX B ATAC OPERATING INSTRUCTIONS

Power Up

Turn on front panel power then turn on power supplies.

Power Down

'Halt'

'Master Clear'

Power off to supplies, power off to control panel.

Run Program

'Master Clear'

Dial 'I/R'

'AUX REG'

'ENTER' (associated with AUX REG)

'MEMORY'

Set start address +1 in keyboard (Hexadecimal)

'PCR'

'ENTER' (associated with PCR)

'RUN'

Stop a Program

'HALT'

Read Memory (from front panel)

'HALT'

Set desired address in key board

Select 'MAR'

'ENTER' (associated with MAR)

'INC' (increment)

'DEC' (decrement)

Address is displayed above MAR key, data is displayed in red LEDs above MEMORY key.

Use INC or DEC as necessary to arrive at memory location desired.

Write into Memory (from front panel)

'HALT'

Set address desired as described in Read Memory.

Set desired data into keyboard

'ENTER' (associated with MEMORY)

Value in keyboard will be entered into either Memory (MEMORY) or A computer Register (FILE).

Bootstrap Load (paper tape)

'HALT'

'MASTER CLEAR'

'AUX REG'

Dial 'IMR'

'ENTER' (associated with AUX REG)

'MEMORY'

Set 0001 in keyboard

(0001 = Load, 0002 = Verify only)

'RUN'

At end of tape check program status lights (red LEDs
below PCR and MAR pushbuttons)

0000 = Load good

FFFE = Parity error

FFFD = Verify error

APPENDIX C

ATAC PROGRAM ASSEMBLY

Assembly of a program is divided into five parts; writing, producing absolute deck on IBM 360, conversion of absolute deck into ATAC format, punching paper tape, and loading ATAC.

A. Writing the program.

Programs for the ATAC must be written in the assembly language described in ATAC manuals Volumes One, and Eight. The finished program must be placed on cards for the IBM 360 in the following format:



B. Producing an absolute deck

The first step is to load the assembler on to the IBM 360 from magnetic tape. This is done by executing program A in Appendix E. This transfers the program from tape to disk and saves it for one year. Once the assembler is stored the

following cards placed in the front of a program written following the instructions in I above will produce an absolute deck and a print-out of the program.

```
//ATACASSM JOB (0729,0194,0052),'CCH ATAC ASSEM,',TIME=1
//ASSEM      EXEC PGM=APSS,REGION=220K
//STEPLIB DD  DSN=S0729.ATAC.ONE,UNIT=3330,
//              VOL=SER=DISK02,DISP=SHR
//FT06F001 DD  SYSCUT=A
//FT07F001 DD  SYSCUT=B
//FT05F001 DD  DDNAME=SYSIN
//FT08F001 DD  UNIT=SYSDA,SPACE=(CYL,1)
//FT09F001 DD  UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCR=(RECFM=VRS,BLKSIZE=7180,LRFCL=92)
//FT10F001 DD  UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCR=(RECFM=VRS,BLKSIZE=4204,LRFCL=42)
//FT20F001 DD  UNIT=SYSDA,SPACE=(CYL,(7,2)),
//              DCR=(RECFM=VRS,BLKSIZE=2004,LRFCL=500)
//SYSPRINT DD  SYSCUT=A
//SYSIN      DD  *
$JOB
$ASSEM
          IDT    ATAC
```

(place written program here.)

```
          END
$BASE
$LOAD      P
$END
```

The absolute deck is in the form:

```
0500169c0009adbc3109bc9c3109c8bc7109c09c7109d8b60309bbd932/
                                                    /e10100009c015a
05101609f49c0109f6ec0008aee1010a02ed000230e10109f7ed0007ae/
                                                    /c1070509201258
```

which must be translated for the ATAC. The memory location of the first word is located in the first four columns.

Columns five and six contain the number of word fields on the card. The assembled program is located in columns 7 - 70. The remaining two columns are parity.

C. Conversion

The absolute deck received from the IBM 360 is loaded into the PDP-11. After the data from the cards is checked, the conversion program (convert 'filename' 'filename') can be executed. (Program C in Appendix F)

D. Punching Paper Tape

This code must then be transferred to the PDP-11 (A) where a paper tape can be punched. Here, the command to punch a tape is:

```
cat 'filename' >/dev/ptp
```

E. Loading the ATAC

In order to load a tape the RS232 connector must be connected to the Paper Tape reader and the reader set to 1200 baud. The tape is loaded by following the instructions in Appendix B.

APPENDIX D

SAMPLE ATAC OUTPUT

Operator inputs are underlined.

| Operator Display | *Comments |
|-------------------------|-------------------------|
| EXEC | *Executive echos |
| + <u>JDKDKJFJJjnmun</u> | *entries other than |
| JDKDKJFJJJNMUH | *commands |
| EXEC | |
| + <u>CO</u> | *Entry into CORE |
| CORE | |
| + <u>CH 0F00 0900</u> | *Location 0F00 |
| 0F00 0900 | *changed to 0900 |
| CORE | |
| + <u>DI 0F00</u> | |
| 0F00 0900 | |
| CORE | |
| + <u>CS 0F00</u> | *Locations 0F00 to 0F03 |
| + <u>0256</u> | *changed |
| + <u>0123</u> | |
| + <u>4567</u> | |
| + <u>DO</u> | *completion of change |
| 0F00 0256 | |
| 0F01 0123 | |
| 0F02 4567 | |
| CORE | |
| + <u>DO</u> | *Exit from CORE |
| + <u>WJ</u> | *Entry into Receiver |
| 0=SET-UP | *Control |
| 1=DISPLAY TENTATIVE | |
| 2=DISPLAY CONTROL | |
| 3=DISPLAY RECEIVED | |
| 4=ENTER TENTATIVE | |
| 5=SCAN | |

6=RECEIVE CONTROL

7=DONF

8=REINITIALIZE

RECEIVER CONTROL

+0

FREQ(HZ)

+1240000

DETECT MODE

0=AM

1=FM

2=BFO FIXED

3=BFO VARIABLE

4=ISB

5=USB

6=LSB

7=AM-NL

+0

GAIN MODE

0=HOLD AGC

2=NORMAL AGC

3=MANUAL AGC

+0

IF BANDWIDTH

1=500 HZ

2=2 KHZ

3=4 KHZ

4=8 KHZ

+4

RF GAIN

(PERCENTAGE)

+88

RECEIVER CONTROL

+1

FREQ = 1240000 HZ

GAIN MODE = HOLD AGC

IF BANDWIDTH = 2 KHZ

DETECT MODE = AM

BFO FREQ = 455000 HZ

RF GAIN = 88%

RECEIVER CONTROL

+2

FREQ = 550000 HZ
GAIN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%

RECEIVER CONTROL

+3

FREQ = 550000 HZ
GAN MODE = NORMAL AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 85%
SIGNAL STRENGTH = 66%

RECEIVER CONTROL

+4

RECEIVER CONTROL

+5

SCAN
START FREQ IN HZ

+1000000

END FREQ IN HZ

+1008000

FREQ INCREMENT IN HZ

+1000

SIGNAL STRENGTH %

+67

FREQ = 1001000
GAIN MODE = HOLD AGC
IF BANDWIDTH = 8 KHZ
DETECT MODE = AM
BFO FREQUENCY = 455000 HZ
RF GAIN = 88%
SIGNAL STRENGTH = 72%

RECEIVER CONTROL

+7

EXEC

+

*Exit from
*Receiver Control

APPENDIX E CONVERSION PROGRAMS FOR THE ASSEMBLER

A. This program is run on the IBM-360 to transfer the ATAC assembler from tape ATT-006 to Disk and stores it there for one year.

```
// (GREEN JOB CARD)
//SYSPRINT DD   SYSOUT=A
//SYSUT1  DD   UNIT=SYSDA,SPACE=(TRK,(40),,CONTIG)
//DA1     DD   UNIT=2314,DSN=S0729.ATAC.ONE,
//          SPACE=(TRK,(50,10,10),,CONTIG),
//          DISP=(NEW,KEEP),VOL=SER=SPOOL3
//T1TAPE DD UNIT=(2400,,OFFER),DISP=(NEW,PASS),
//          LABEL=(3,SL,,IN),
//          DCR=(DCR=2,BLKSIZE=800,LRECL=80,RECFM=FB),
//          VOL=SER=ATI006
//SYSIN    DD   *
//          COPY PDS=ATI.APSS.LOADLIB,TO=2314=SPOOL3,
//          FROMDD=T1TAPE,FROM=2400=(ATI006,3),
//          RENAME=S0729.ATAC.ONE

/*
//BUILD      EXEC PGM=IEWL,REGION=150K,
//          PARM='ONLY,XREF,LET,LIST,SIZE=(256K,20480)'
//SYSPRINT DD   SYSOUT=A
//LIBRARY DD DSN=S0729.ATAC.ONE,UNIT=2314,VOL=SER=SPOOL3,
//          DISP=SHR
//SYSLIB DD DSN=SYS1.FORTLIB,DISP=SHR
//SYSLMOD DD DSN=S0729.ATAC.ONE,
//          UNIT=3330,VOL=SER=DISK02,
//          DISP=(NEW,KEEP),LABEL=RETPD=360,
//          SPACE=(CYL,(5,1,2),RLSE)
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(19,19),,CONTIG),
//          SEP=SYSLMOD
//SYSLIN    DD   *
//          INCLUDE LIBRARY(PMODL)
//          CHANGE MSIM(IHESAPD)
//          INCLUDE LIBRARY(APSSMON)
//          INCLUDE LIBRARY(MSIM4,ASEM5,SIM16A,SIMTR1,SIMIO1,GUL)
//          INCLUDE LIBRARY(XPLMON)
//          OVERLAY A1
//          INSERT MSIMUL,*MSIMULA,IHENTRY,IHESAP
//          INSERT MINT,IN,OUT
//          INSERT IHEDBN,IHEXTD
```



```

INSERT IHERSM,IHECSM
INSERT IHERSK,IHFIOX,IHEIOP,IHEDID,IHEDOR
INSERT IHEDIR,IHEDOA,IHEIOR
INSERT IHEIOA,IHEOCL
INSERT IHERSD,IHEBSF
INSERT IHEJXS
INSERT IHEOSD,IHEOST,IHERST
INSERT IHEVPF,IHFDMA,IHEVER
INSERT IHEDNC,IHEVFD,IHEVFA,IHEVPD,IHEVPB,IHEVSC
INSERT IHEVSD,IHEVFE,IHEDCN,IHEUPB
INSERT IHEVFC,IHEVPE,IHEVPG,IHEVOB,IHEVGC
INSERT IHEABN,IHEIDD,IHEIOF,IHEPRT,IHEVQA,IHESPR
INSERT IHEREG,IHERERR,IHESI7
INSERT MISEI
OVERLAY A1
INSERT ASSEM,REWIND,REW72,DSKOUT,CARDIN,DISKIN,ERPRT,PRIADD
INSERT WRDATA,PRICOM,PPINOP,WRITEX,REFTIT,PREF,ERTTT
OVERLAY A1
INSERT PARMRD,PRESTM
OVERLAY A1
INSERT SMLTR,NRMTRM,STRISM,TRAGE
INSERT RDCPD,ABNPMT,ARTHER,TRACE,HGRAM,HGRAMI,HGRAMS
INSERT IQINIT,ACTIVE,STMTIM
INSERT DEVDTA,ACT,TIME,INT,RAND,DEADT,DEBUG
OVERLAY A2
INSERT LEVEL,DMAIOI,DMAIOA,DMAIOD,RIDIO
INSERT REMACT,DMA,DMAIM,RIO,RIOIM,RIOINT,INTOLY,DMAINT
INSERT DTRAN,PUTACT,RANDOM
OVERLAY A1
INSERT HGPRNT
OVERLAY A1
INSERT LOADER
OVERLAY A1
INSERT LINK,ENTEXT,SILH
OVERLAY A1
INSERT PLATAC,TOPACK
OVERLAY $OBJECT(REGION)
INSERT OBJECT,INIT,LIB,RCALPH,RCHEX,RCINT
INSERT MDATE
OVERLAY $DUMP(REGION)
INSERT $DUMP,PAGE
ENTRY MAIN
NAME APSS
/*
//          EXEC PGM=IEBCOPY
//SYSPRINT DD   SYSOUT=A
//SYSUT1  DD   DISP=SHR,UNIT=2314,VOL=SER=SP00L3,
//          DSN=S0729.ATAC.ONE
//SYSUT2 DD   DISP=(NEW,PASS),UNIT=3330,VOL=SER=DISK02,
//          DSN=S0729.ATAC.TWO,

```



```

//          SPACE=(13030,(61,0,14),RLSE),
//          DCB=(RECFM=U,BLKSIZE=13030),
//          ,LABEL=RETPD=360
//SYSUT3 DD UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSUT4 DD UNIT=SYSDA,SPACE=(TRK,(20,5))
//SYSIN DD *
COPY OUTDD=SYSUT2,INDD=SYSUT1

```

B. This program converts the IBM-360 absolute deck into correct format for the ATAC.

```

main (argc, *argv)
int argc;
char *argv [1];
{register crctr, index, index;
int stchr;
int tmpary [72];
struct bufin
{int fldes;
int nleft;
char *nextp;
char *buffs [512];
} bufin, bufot, *pntr1, *pntr2;
stchr = 020;
if (argc != 3)
{printf ("Calling arguments are incorrect#");
exit (0);
}
bufin.fldes = open (argv [1], 0);
if (bufin.fldes < 0)
{printf ("Cannot open %s#", argv [1]);
exit (0);
}
pntr1 = &bufin.fldes;
bufot.fldes = creat (argv [2], 0777);
if (bufot.fldes < 0)
{printf ("Cannot open %s#", argv [2]);
exit (0);
}
pntr2 = &bufot.fldes;
putc (stchr, pntr2);
while (crctr >= 0 && index <= 72)
tmpary [index++] = (crctr =getc (pntr1));
index = - 3;
index = 0;
while (index < 4 && index < index)

```



```

        putc (tmpary [index++], pnter2);
index = index + 2;
while (crctr >= 0)
    {while (index < index)
        {if (tmpary [index] == '#')
            index++;
        else
            putc (tmpary [index++], pnter2);
        }
    index = 0;
    while (crctr >= 0 && index <= 72)
        tmpary [index++] = (crctr =getc (pnter1));
    index -= 3;
    index = 0;
}
putc (stchr, pnter2);
fflush (pnter2);
close (bufin.fdces);
close (bufot.fdces);
}

```

C. The following program executes the program above and converts the output into the correct code.

```

atasc $1 $2
if ! -r $2 exit
mv $2 temp2
tr "[0*]" "[040*]" <temp2 >temp1
tr "[1*]" "[001*]" <temp1 >temp2
tr "[2*]" "[002*]" <temp2 >temp1
tr "[3*]" "[043*]" <temp1 >temp2
tr "[4*]" "[004*]" <temp2 >temp1
tr "[5*]" "[045*]" <temp1 >temp2
tr "[6*]" "[046*]" <temp2 >temp1
tr "[7*]" "[007*]" <temp1 >temp2
tr "[8*]" "[010*]" <temp2 >temp1
tr "[9*]" "[051*]" <temp1 >temp2
tr "[a*]" "[052*]" <temp2 >temp1
tr "[b*]" "[013*]" <temp1 >temp2
tr "[c*]" "[054*]" <temp2 >temp1
tr "[d*]" "[015*]" <temp1 >temp2
tr "[e*]" "[016*]" <temp2 >temp1
tr "[f*]" "[057*]" <temp1 >$2
rm temp1 temp2

```


APPENDIX F
ATAC PROGRAM

The following programs are listings of the Main System and Receiver Control programs for the ATAC. The assembly language is to the right of the absolute listing of the first three columns.

| ATAC | LOC | OBJECT CODE | CARD IMAGE | TIME: 15:22:49 | 03/21/77 | PAGE | CARDNUM |
|------|------|-------------|-------------------|------------------------------------|----------|------|---------|
| | 0117 | A446 | IOR R,EU,EL | COMBINE FIRST TWO BYTES OF COMMAND | | | 55 |
| | 0118 | B106 776A | CHP I,EU,0776A | SEE IF REQUEST FOR WJ | | | 56 |
| | 011A | C102 012A | BRCL EQ,EX2 | GO CALL WJ | | | 57 |
| | 011C | 0000 | NOP | PATCH AREA FOR ANOTHER REQUEST | | | 58 |
| | 011D | 0000 | NOP | | | | 59 |
| | 011E | 0000 | NOP | | | | 60 |
| | 011F | 0000 | NOP | | | | 61 |
| | | | | | | | 62 |
| | | | | | | | 63 |
| | | | | | | | 64 |
| | | | | | | | 65 |
| | 0120 | BCF0 0136 | LDRM D,0,EXECS,16 | RESTORE REGISTERS | | | 66 |
| | 0122 | ED00 0230 | BAL I,0,OUTPUT | ECHO INPUT BUFFER | | | 67 |
| | 0124 | E101 014A | LDR I,1,EXCRLF | GET ADDRESS OF CR/LF BUFFER | | | 68 |
| | 0126 | ED00 0230 | BAL I,0,OUTPUT | OUTPUT CR/LF | | | 69 |
| | 0128 | C107 0100 | BRC I,7,EXEC | GO TRY AGAIN | | | 70 |
| | | | | | | | 71 |
| | | | | | | | 72 |
| | | | | | | | 73 |
| | 012A | ED00 0500 | BAL I,RET,WJ | GO TO WJ | | | 74 |
| | 012C | C107 0100 | BRCL U,EXEC | | | | 75 |
| | | | | | | | 76 |
| | | | | | | | 77 |
| | | | | | | | 78 |
| | | | | | | | 79 |
| | 012E | 0000 | NOP | | | | 80 |
| | 012F | 0000 | NOP | | | | 81 |
| | 0130 | 0000 | NOP | | | | 82 |
| | 0131 | 0000 | NOP | | | | 83 |
| | 0132 | 0000 | NOP | | | | 84 |
| | 0133 | 0000 | NOP | | | | 85 |
| | 0134 | C107 0100 | BRCL U,EXEC | | | | 86 |
| | | | | | | | 87 |
| | | | | | | | 88 |
| | | | | | | | 89 |
| | | | | | | | 90 |
| | | | | | | | 91 |
| | | | | | | | 92 |
| | | | | | | | 93 |
| | | | | | | | 94 |
| | 0136 | | EXECS DS 20 | SAVE AREA FOR REGISTERS | | | 95 |
| | 014A | 0001 | EXCRLF DC 1 | | | | 96 |
| | 014B | 000A | DC 00D0A | CR/LF | | | 97 |
| | 014C | 0000 | DC 0 | | | | 98 |
| | 014D | 0003 | DC 3 | COUNT | | | 99 |
| | 014E | 4558 | DC 04558 | EX | | | 100 |
| | 014F | 4543 | DC 04543 | EC | | | 101 |
| | 0150 | 0000 | DC 0 | NULL | | | 102 |
| | | | | | | | 103 |
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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|-----|-------------|-------------------------------------------------------|---------|
| . | . | ***** | 108 |
| . | . | SYSTEM EQUATES | 109 |
| . | . | ***** | 110 |
| . | . | THESE ARE EQUATES THAT ARE USED FOR LINKAGE BETWEEN | 111 |
| . | . | PROGRAMS OR THAT ARE USED BY AT LEAST TWO PROGRAMS IN | 112 |
| . | . | THE SYSTEM | 113 |
| . | . | ***** | 114 |
| . | . | ***** | 115 |
| . | . | ***** | 116 |
| . | . | ***** | 117 |
| . | . | RET EQU 0 RETURN REGISTER | 118 |
| . | . | ***** | 119 |
| . | . | KEYMR | 120 |
| . | . | ***** | 121 |
| . | . | ROUTINE TO READ DATA FROM THE KEYBOARD | 122 |
| . | . | ***** | 123 |
| . | . | CALLING PROCEDURE: | 124 |
| . | . | BAL I,0,KEYMR | 125 |
| . | . | ***** | 126 |
| . | . | INPUTS: NONE | 127 |
| . | . | ***** | 128 |
| . | . | ***** | 129 |
| . | . | ***** | 130 |
| . | . | ***** | 131 |
| . | . | ***** | 132 |
| . | . | ***** | 133 |
| . | . | ***** | 134 |
| . | . | ***** | 135 |
| . | . | ***** | 136 |
| . | . | ***** | 137 |
| . | . | ***** | 138 |
| . | . | ***** | 139 |
| . | . | ***** | 140 |
| . | . | ***** | 141 |
| . | . | ***** | 142 |
| . | . | ***** | 143 |
| . | . | ***** | 144 |
| . | . | ***** | 145 |
| . | . | ***** | 146 |
| . | . | ***** | 147 |
| . | . | ***** | 148 |
| . | . | ***** | 149 |
| . | . | ***** | 150 |
| . | . | ***** | 151 |
| . | . | ***** | 152 |
| . | . | ***** | 153 |
| . | . | ***** | 154 |
| . | . | ***** | 155 |
| . | . | ***** | 156 |
| . | . | ***** | 157 |
| . | . | ***** | 158 |
| . | . | ***** | 159 |
| . | . | ***** | 160 |

KRET EQU 0
 KBUP EQU 1
 KPC EQU 5
 KPM EQU 6
 KOR EQU 7
 KIR EQU 8
 KOUT EQU 9
 KIN EQU 10
 KVI EQU 11

RETURN REGISTER
 ADDRESS OF BUFFER HOLDING KEYBOARD
 ENTRY
 POSITION COUNTER FOR NEXT INPUT
 INPUT FROM KEYBOARD (CURSOR)
 MAX POSITION USED IN KEYBOARD ENTRY
 (NUMBER OF CHARACTERS ENTERED)
 OUTPUT REGISTER
 INPUT REGISTER
 OUTPUT DEVICE ADDRESS
 INPUT DEVICE ADDRESS
 VARIABLE 1

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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|--------------------------|---------|
| 0151 | 9C00 01D6 | KV2 EQU 12 | 161 |
| 0153 | E101 0228 | KV3 EQU 13 | 162 |
| 0155 | ED00 0230 | KDATA EQU 14 | 163 |
| 0157 | E10A FFEF | VARIABLE 2 | 164 |
| 0159 | E109 BFFF | VARIABLE 3 | 165 |
| 015B | 4015 | INPUT DATA FROM KEYBOARD | 166 |
| 015C | 4016 | | 167 |
| 015D | E101 01D7 | | 168 |
| 015F | E107 8000 | | 169 |
| 0161 | D997 | | 170 |
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| LOC | OBJECT CODE | CARD IMAGE | PAGE | CARDNUM |
|------|-------------|-------------------------------|------|---------|
| 0179 | A10E 007F | AND I,KDATA,0007F | | 214 |
| 017B | 208E | CMP IS,KDATA,008 | | 215 |
| 017C | C105 0184 | BRCL NE,KMR6 | | 216 |
| 017E | 6FF5 | ADD IS,KDEC-1 | | 217 |
| 017F | C105 0169 | BRCL NZ,KMR3 | | 218 |
| 0181 | 4015 | LDR IS,KPC,1 | | 219 |
| 0182 | C107 0169 | BRCL U,KMR3 | | 220 |
| 0184 | 21CE | CMP IS,KDATA,01C | | 221 |
| 0185 | C105 0190 | BRCL NE,KMR8 | | 222 |
| 0187 | 6015 | ADD IS,KPC,1 | | 223 |
| 0188 | B105 0050 | CMP LE,KPC,80 | | 224 |
| 018A | C106 0169 | BRCL I,KMR3 | | 225 |
| 018C | E105 0050 | LDR I,KPC,80 | | 226 |
| 018E | C107 01B9 | BRCL U,KMR1 | | 227 |
| 0190 | 20DE | CMP IS,KDATA,00D | | 228 |
| 0191 | C102 01B9 | BRCL EQ,KMR1 | | 229 |
| 0193 | 22EE | CMP IS,KDATA,02E | | 230 |
| 0194 | C102 01B1 | BRCL EQ,KMR10 | | 231 |
| 0196 | 220E | CMP IS,KDATA,020 | | 232 |
| 0197 | C102 01B1 | BRCL EQ,KMR10 | | 233 |
| 0199 | 230E | CMP IS,KDATA,030 | | 234 |
| 019A | C104 01AB | BRCL LT,KMR9 | | 235 |
| 019C | 239E | CMP IS,KDATA,039 | | 236 |
| 019D | C106 01B1 | BRCL LE,KMR10 | | 237 |
| 019F | 241E | CMP IS,KDATA,041 | | 238 |
| 01A0 | C104 01AB | BRCL LT,KMR9 | | 239 |
| 01A2 | 25AE | CMP IS,KDATA,05A | | 240 |
| 01A3 | C106 01B1 | BRCL LE,KMR10 | | 241 |
| 01A5 | 261E | CMP IS,KDATA,061 | | 242 |
| 01A6 | C104 01AB | BRCL LT,KMR9 | | 243 |
| 01A8 | 27AE | CMP IS,KDATA,07A | | 244 |
| 01A9 | C106 01B1 | BRCL LE,KMR10 | | 245 |
| | | ***** | | 246 |
| | | ILLEGAL ENTRY | | 247 |
| | | ***** | | 248 |
| 01AB | E101 022C | LDR I,KBUF,KBILL | | 249 |
| 01AD | ED00 0230 | BAL I,KRET,OUTPUT | | 250 |
| 01AF | C107 0153 | BRCL U,KMR1 | | 251 |
| | | GET ADDRESS OF ILLEGAL BUFFER | | 252 |
| | | OUTPUT BUFFER | | 253 |
| | | START OVER | | 254 |
| | | | | 255 |
| | | | | 256 |
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| | | | | 266 |

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ATAC

CARDNUM

CARD IMAGE

OBJECT CODE

LOC

```

*****
: VALID ENTRY - PUT IN BUFFER
: *****
:
KMR10 STR DX,KDATA,KBUFFER,KPC PUT DATA IN BUFFER
      CMP R,KPM,KPC COMPARE MAX USED WITH
      BRCL GE,KMR7 GO INCREMENT POSITION COUNTER
      LDR R,KPM,KPC PM = PC
      BRCL U,KMR7 KEEP GETTING DATA

:
:
: *****
: EXIT
: *****
:
KMR11 STR D,KPM,KBUFFER PUT COUNT IN BUFFER
:
: THIS IS THE SEQUENCE FOR CALLING 'CORE'. (UTILITY TO DISPLAY AND
: CHANGE CORE INTERACTIVELY). ALL CODE BETWEEN DOTTED LINES MAY BE
: REMOVED WHEN A CALL TO THAT PROGRAM IS NO LONGER DESIRED.
:
KMR30
      LDR R,KV1,KBUP
      IS,KPC,0
      ADD IS,KV1,1
      LDR RX,KV2,KV1,KPC
      ADD IS,KPM,-1
      BRCL NP,KMR12
      CMP IS,KV2,020
      BRCL EQ,KMR30
      ADD IS,KV1,1
      SHS LL,KV2,8
      LDR RX,KV3,KV1,KPC
      SHS LL,KV3,8
      SHS RL,KV3,8
      ADD R,KV2,KV3
      CMP I,KV2,0636F
      BRCL NE,KMR12
      LDR D,KMR12
      BRC I,7,CORE

:
:
: *****
: KMR12 LDR D,KRET,RETURN
:       BRC R,7,KRET
:
:
:
:
: *****
: DATA
: *****
:
: RETURN DS 1
:
: *****

```

RETURN ADDRESS STORAGE

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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|----------------------------------------------------|---------|
| 01D7 | 0050 | KEYBOARD ENTRY BUFFER | 320 |
| 01D8 | | ***** | 321 |
| | | KBUFFER DC 80 | 322 |
| | | DS 80 | 323 |
| | | COUNT | 324 |
| | | RESERVE | 325 |
| | | ***** | 326 |
| | | START SYMBOL BUFFER | 327 |
| | | ***** | 328 |
| | | ***** | 329 |
| 0228 | 0003 | KBSTRT DC 3 | 330 |
| 0229 | 000A | DC 00D0A | 331 |
| 022A | 002B | DC 002B | 332 |
| 022B | 0000 | DC 00000 | 333 |
| | | COUNT | 334 |
| | | CR/LF | 335 |
| | | + | 336 |
| | | NULL | 337 |
| | | ***** | 338 |
| | | ILLEGAL CHARACTER BUFFER | 339 |
| | | ***** | 340 |
| | | ***** | 341 |
| 022C | 0003 | KBILL DC 3 | 342 |
| 022D | 0A07 | DC 00A07 | 343 |
| 022E | 0707 | DC 00707 | 344 |
| 022F | 0000 | DC 00000 | 345 |
| | | COUNT | 346 |
| | | CR, BELL | 347 |
| | | BELL, BELL | 348 |
| | | NULL | 349 |
| | | ***** | 350 |
| | | ROUTINE TO OUTPUT TO THE TTY/CRT | 351 |
| | | ***** | 352 |
| | | CALLING PROCEDURE: | 353 |
| | | BAL I,0,OUTPUT | 354 |
| | | ***** | 355 |
| | | INPUTS: | 356 |
| | | REG 1 ADDRESS OF BUFFER TO BE OUTPUT | 357 |
| | | ***** | 358 |
| | | THE BUFFER MUST BE SET UP IN THE FOLLOWING MANNER: | 359 |
| | | WORD 1 N = NUMBER OF WORDS IN BUFFER TO BE OUTPUT | 360 |
| | | WORDS 2-N ASCII DATA TO BE OUTPUT, TWO ASCII | 361 |
| | | CHARACTERS PER WORD | 362 |
| | | ***** | 363 |
| | | OUTPUTS: | 364 |
| | | NONE | 365 |
| | | ROUTINES CALLED: | 366 |
| | | NONE | 367 |
| | | ***** | 368 |
| | | THIS ROUTINE PRESERVES NO REGISTERS | 369 |
| | | ***** | 370 |
| | | ***** | 371 |
| | | ***** | 372 |

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| LOC | OBJECT CODE | CARD IMAGE | PAGE | CARDNUM |
|------|-------------|-------------------|------|---------|
| 0230 | 400C | ***** | 40 | 373 |
| 0231 | 401D | ESTABLISH EQUATES | 40 | 374 |
| 0232 | E106 | ***** | 40 | 375 |
| 0233 | E107 | ***** | 40 | 376 |
| 0234 | 51CB | ***** | 40 | 377 |
| 0235 | 9C0C | ***** | 40 | 378 |
| 0236 | 200B | ***** | 40 | 379 |
| 0237 | C106 | ***** | 40 | 380 |
| 0238 | 228B | ***** | 40 | 381 |
| 0239 | C106 | ***** | 40 | 382 |
| 0240 | 9C0B | ***** | 40 | 383 |
| 0241 | 428B | ***** | 40 | 384 |
| 0242 | E0BA | ***** | 40 | 385 |
| 0243 | AE0A | ***** | 40 | 386 |
| 0244 | E105 | ***** | 40 | 387 |
| | | ***** | 40 | 388 |
| | | ***** | 40 | 389 |
| | | ***** | 40 | 390 |
| | | ***** | 40 | 391 |
| | | ***** | 40 | 392 |
| | | ***** | 40 | 393 |
| | | ***** | 40 | 394 |
| | | ***** | 40 | 395 |
| | | ***** | 40 | 396 |
| | | ***** | 40 | 397 |
| | | ***** | 40 | 398 |
| | | ***** | 40 | 399 |
| | | ***** | 40 | 400 |
| | | ***** | 40 | 401 |
| | | ***** | 40 | 402 |
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| | | ***** | 40 | 406 |
| | | ***** | 40 | 407 |
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| | | ***** | 40 | 409 |
| | | ***** | 40 | 410 |
| | | ***** | 40 | 411 |
| | | ***** | 40 | 412 |
| | | ***** | 40 | 413 |
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| | | ***** | 40 | 415 |
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| | | ***** | 40 | 419 |
| | | ***** | 40 | 420 |
| | | ***** | 40 | 421 |
| | | ***** | 40 | 422 |
| | | ***** | 40 | 423 |
| | | ***** | 40 | 424 |
| | | ***** | 40 | 425 |

 ESTABLISH EQUATES

ADDRESS OF BUFFER TO OUTPUT
 OUTPUT BUFFER ADDRESS
 INPUT DEVICE ADDRESS
 OUTPUT DEVICE ADDRESS
 INPUT BUFFER LOWER BYTE
 INPUT BUFFER UPPER BYTE
 NUMBER OF WORDS TO OUTPUT
 NUMBER OF WORDS TO INPUT
 UPPER BYTE INDEX
 LOWER BYTE INDEX
 STATUS
 WORD TO OUTPUT TO TTY

 INITIALIZE AND SET UP CONSTANTS

INDEX FOR STORING UPPER BYTE
 INDEX FOR STORING LOWER BYTE
 INPUT DEVICE ADDRESS
 OUTPUT DEVICE ADDRESS
 GET INPUT WORD COUNT
 INITIALIZE COUNT
 COMPARE WORD COUNT WITH ZERO
 GET OUT IF COUNT LESS THAN ZERO
 COMPARE WITH MAX VALUE
 IF IN LIMIT KEEP GOING
 SAVE ORIGINAL COUNT
 ONLY OUTPUT 40 WORDS
 PUT IN OUTPUT WORD COUNT
 DOUBLE FOR OUTPUT WORD COUNT
 GET OUTPUT BUFFER ADDRESS

 TRANSFER INPUT BYTE BUFFER TO OUTPUT WORD BUFFER

INCREMENT INPUT POINTER TO NEXT ENTR
 GET INPUT WORD IN UPPER BYTE REGISTE
 PUT IN LOWER BYTE REGISTER ALSO
 CLEAR UPPER BYTE
 RIGHT JUSTIFY LOWER BYTE
 RIGHT JUSTIFY UPPER BYTE
 STORE UPPER BYTE AS FULL WORD
 IN THE OUTPUT BUFFER
 STORE LOWER BYTE AS FULL WORD

0230 400C
 0231 401D
 0232 E106
 0233 E107
 0234 51CB
 0235 9C0C
 0236 200B
 0237 C106
 0238 228B
 0239 C106
 0240 9C0B
 0241 428B
 0242 E0BA
 0243 AE0A
 0244 E105

0246 6011
 0247 51C9
 0248 E098
 0249 AE78
 024A AD78
 024B AD79
 024C 15C9
 024D 15D8

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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------------------------------------------------|---------|
| 02BB | 9C00 02E1 | REG 2 MOST SIGNIFICANT TWO DIGITS IN ASCII | 479 |
| 02BD | E014 | REG 3 LEAST SIGNIFICANT TWO DIGITS IN ASCII | 480 |
| 02BE | ADB4 | LETTERS ARE OUTPUT IN UPPER CASE | 481 |
| 02BF | ED00 02DB | ROUTINES CALLED: | 482 |
| 02C1 | AE74 | NONE | 483 |
| 02C2 | E042 | THIS ROUTINE DOES NOT DISTURB REGISTERS 5 THROUGH 15 | 484 |
| 02C3 | E014 | ***** | 485 |
| 02C4 | AD74 | ***** | 486 |
| 02C5 | A104 000F | ***** | 487 |
| 02C6 | ED00 02DB | ***** | 488 |
| 02C7 | E042 | ***** | 489 |
| 02C8 | E014 | ***** | 490 |
| 02CB | A104 00F0 | ***** | 491 |
| 02CD | AD34 | ***** | 492 |
| 02CE | ED00 02DB | ***** | 493 |
| 02D0 | AE74 | ***** | 494 |
| 02D1 | E043 | ***** | 495 |
| 02D2 | E014 | ***** | 496 |
| 02D3 | A104 000F | ***** | 497 |
| 02D5 | ED00 02DB | ***** | 498 |
| 02D7 | 8043 | ***** | 499 |
| | | ***** | 500 |
| | | ***** | 501 |
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| | | ***** | 531 |

HIN EQU 1
 MSD EQU 2
 LSD EQU 3
 V1 EQU 4

HEX VALUE INPUT
 MOST SIGNIFICANT DIGITS TO OUTPUT
 LEAST SIGNIFICANT DIGITS TO OUTPUT
 VARIABLE

SAVE RETURN REGISTER
 GET HEX INPUT VALUE
 RIGHT JUSTIFY FIRST DIGIT
 CONVERT FIRST DIGIT
 POSITION DIGIT
 PUT IN OUTPUT REGISTER
 GET HEX INPUT VALUE
 RIGHT JUSTIFY SECOND DIGIT
 CLEAR ALL BUT SECOND DIGIT
 CONVERT SECOND DIGIT
 PUT IN OUTPUT REGISTER
 GET HEX INPUT VALUE
 CLEAR ALL BUT THIRD DIGIT
 RIGHT JUSTIFY THIRD DIGIT
 CONVERT THIRD DIGIT
 POSITION DIGIT
 PUT IN OUTPUT REGISTER
 GET HEX INPUT VALUE
 CLEAR ALL BUT FOURTH DIGIT
 CONVERT FOURTH DIGIT
 PUT IN OUTPUT REGISTER

D,RET,HEXRTN
 R,V1,HIN
 RL,V1,12
 I,RET,HEXA1
 LL,V1,8
 R,MSD,V1
 LDR R,V1,HIN
 SHS RL,V1,8
 AND I,V1,0000F
 I,RET,HEXA1
 R,MSD,V1
 ADD R,V1,HIN
 LDR R,V1,HIN
 AND I,V1,0000F
 SHS RL,V1,4
 I,RET,HEXA1
 BAL RL,V1,8
 SHS RL,V1,8
 LDR R,LSD,V1
 AND R,V1,HIN
 I,V1,OF
 I,RET,HEXA1
 BAL R,LSD,V1
 ADD

 EXIT

CARDNUM

CARD IMAGE

LOC OBJECT CODE

02D8 E200 02E1 LDR D,RET,HEXRTN GET RETURN ADDRESS
02DA BF07 BRC R,7,RET RETURN

* CONVERT ONE DIGIT *

02DB 20A4 CMP IS,V1,00A COMPARE WITH HEX 'A'
02DC C104 02DF BRCL LF,HEXA2 BRANCH IF LESS
02DE 6074 ADD IS,V1,7 ADD 7 TO VALUE
02DF 6304 ADD IS,V1,30 ADD HEX '30'
02E0 BF07 BRC R,7,RET GO BACK TO WHERE CALLED FROM

* DATA *

02E1 HEXRTN DS 1 SAVE LOCATION FOR RETURN ADDRESS

* ROUTINE TO CONVERT FOUR (4) OR LESS DIGITS IN ASCII *
* CODE TO A TRUE HEX VALUE FOR THE MACHINE. SIGN OF THE *
* VALUE MUST BE HANDLED BY THE CALLING ROUTINE. *

* CALLING PROCEDURE: *
* BAL I,0,AHEX *

* INPUTS: *
* REG 1 ADDRESS OF FIRST CONSECUTIVE LOCATION IN *
* CORE WHERE THE ASCII CHARACTERS ARE LOCATED *
* (ONE CHARACTER PER CORE LOCATION) *

* OUTPUT: *
* REG 2 HEX VALUE *

* ROUTINES CALLED: *
* NONE *

* REGISTERS 8 THROUGH 16 ARE PRESERVED *

* ESTABLISH EQUATES *

* AHAD EQU 1 ADDRESS OF ASCII CHARACTERS
* AHOU EQU 2 OUTPUT HEX VALUE
* AHV1 EQU 5 VARIABLE 1

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CARDNUM

CARD IMAGE

OBJECT CODE

CFLD

C4

C5

C6

R, CMD, CADD

IS, C, INDEX, 1

IS, C, FLAG, -1

U, C3

R, CF1, CADD

U, C7

R, CF2, CADD

IS, CP1, 0

EQ, C8

R, CADD, CP1

I, RET, AHEX

R, CF1, CA1

IS, CF2, 0

EQ, C8

R, CADD, CF2

I, RET, AHEX

R, CF2, CA1

I, CV1, 0646F

EQ, C9

I, CV1, 06475

EQ, C10

I, CV1, 06469

EQ, C11

I, CV1, 06368

EQ, C12

EQ, C13

EQ, C14

EQ, C15

EQ, C16

EQ, C17

EQ, C18

EQ, C19

EQ, C20

EQ, C21

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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|-------------------|---------|
| 0377 | 6FF1 03F1 | ADD IS,CADD,-1 | 850 |
| 0378 | 9C00 040A | STRM D,0,CS1,16 | 851 |
| 037A | ED00 0230 | BAL I,RET,OUTPUT | 852 |
| 037C | BCF0 03F1 | LDRM D,0,CS1,16 | 853 |
| 037E | 6FF7 035A | ADD IS,CINDX,-1 | 854 |
| 037F | C105 035A | BRCL NZ,C13 | 855 |
| 0381 | C107 02FD | BRC I,7,C1 | 856 |
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| 0383 | E001 02BB | LDR R,CADD,CF1 | 866 |
| 0384 | ED00 040A | BAL I,RET,HEXA | 867 |
| 0386 | 9C02 040A | STR D,CA1,CBUD1 | 868 |
| 0388 | 9C03 040B | STR D,CA2,CBUD1+1 | 869 |
| 038A | E3F1 0000 | LDR DX,CADD,0,CF1 | 870 |
| 038C | ED00 02BB | BAL I,RET,HEXA | 871 |
| 038E | 9C02 040D | STR D,CA1,CBUD2 | 872 |
| 0390 | 9C03 040E | STR D,CA2,CBUD2+1 | 873 |
| 0392 | E101 0409 | LDR I,CADD,CBUD | 874 |
| 0394 | ED00 0230 | BAL I,RET,OUTPUT | 875 |
| 0396 | E20F 0412 | LDR D,CF1,CSFLG | 876 |
| 0398 | C105 03C5 | BRCL NZ,C23 | 877 |
| 039A | C107 02FD | BRC I,7,C1 | 878 |
| | | | 879 |
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| | | | 884 |
| | | | 885 |
| 039C | 9BF9 0000 | STR DX,CF2,0,CF1 | 886 |
| 039E | C107 0383 | BRC I,7,C11 | 887 |
| | | | 888 |
| | | | 889 |
| | | | 890 |
| | | | 891 |

DECREMENT BY ONE TO GET COUNT
SAVE REGISTERS
OUTPUT ONE LINE
RESTORE REGISTERS
DECREMENT LINE COUNTER
DO ANOTHER LINE
WAIT FOR ANOTHER COMMAND

GET ADD OF LOCATION TO DISPLAY
CONVERT CORE CONTENTS TO ASCII
PUT MSD IN OUTPUT BUFFER
PUT LSD IN OUTPUT BUFFER
PUT CORE VALUE IN REGISTER
CONVERT ADDRESS TO ASCII
PUT MSD IN OUTPUT BUFFER
PUT LSD IN OUTPUT BUFFER
PUT ADDRESS IN REGISTER
OUTPUT BUFFER TO CRT
GET FLAG FOR SEQUENTIAL CHANGE
GO BACK TO SEQUENTIAL IF FLAG SET
GO AGAIN

CHANGE CORE CONTENTS
GO DISPLAY CORE CHANGE

PAGE

CARDNUM

CARD IMAGE

OBJECT CODE

LOC

| | | | | | | |
|------|------|------|------|-------------------|-----------------------------------|-----|
| 03A0 | 9C0F | 0410 | STR | D,CF1,CSTRT | SAVE START OF CORE CHANGE | 892 |
| 03A2 | 9C0F | 0411 | STR | D,CF1,CSTOR | SAVE ADDRESS AT WHICH TO STORE | 893 |
| 03A4 | 401C | 0412 | LDR | D,CF1,CSTRT | SET UP A CONSTANT 1 | 894 |
| 03A5 | 9C0C | 0412 | STR | D,CF1,CSTRT | SET FLAG FOR SEQUENTIAL CHANGE | 895 |
| 03A7 | 4000 | 0151 | BAL | I,RET,KEYMR | GET VALUE FOR CORE | 896 |
| 03A9 | 400A | | LDR | IS,CZERO,0 | SET UP ZERO REGISTER | 897 |
| 03AA | 6011 | | ADD | IS,CADD,1 | INCREMENT BUFFER POINTER | 898 |
| 03AB | 4015 | | LDR | IS,CV3,1 | SET UP A CONSTANT 1 | 899 |
| 03AC | 51AC | | LDR | RX,CV1,CZERO,CADD | GET FIRST CHARACTER ENTERED | 900 |
| 03AD | 515D | | LDR | RX,CV2,CV3,CADD | GET SECOND CHARACTER ENTERED | 901 |
| 03AE | AE7C | | SHS | LL,CV1,8 | LEFT JUSTIFY FIRST CHARACTER | 902 |
| 03AF | AE7D | | SHS | LL,CV2,8 | CLEAR UPPER 8 BITS OF SECOND CHAR | 903 |
| 03B0 | AD7D | | SHS | RL,CV2,8 | RIGHT JUSTIFY SECOND CHARACTER | 904 |
| 03B1 | 80DC | | ADD | R,CV1,CV2 | COMBINE BOTH CHARACTERS | 905 |
| 03B2 | B10C | | CMP | R,CV1,0646F | COMPARE WITH 'DO' | 906 |
| 03B4 | C102 | 646F | BRCL | E,CV2,1 | GET OUT IF DONE | 907 |
| 03B6 | E200 | 02E2 | BAL | I,RET,AHXX | CONVERT ENTRY TO HEX | 908 |
| 03B8 | E20F | 0411 | LDR | D,CF1,CSTOR | GET ADDRESS FOR STORING | 909 |
| 03BA | 9BF2 | 0000 | STR | DX,CA,0,CF1 | PUT VALUE IN CORE | 910 |
| 03BC | 601F | | ADD | IS,CF1,1 | INCREMENT STORE ADDRESS | 911 |
| 03BD | 9C0F | 0411 | STR | D,CF1,CSTOR | SAVE NEW STORE ADDRESS | 912 |
| 03BF | C107 | 03A7 | BRCL | U,CV1,1 | GO GET ANOTHER ENTRY | 913 |
| 03C1 | E20F | 0410 | LDR | D,CF1,CSTRT | GET ADDRESS OF FIRST CORE CHANGED | 914 |
| 03C3 | C107 | 0383 | BRCL | U,CV1,1 | GO DISPLAY LOCATION | 915 |
| 03C7 | 601C | 0410 | LDR | D,CV1,CSTRT | GET ADDRESS DISPLAYED | 916 |
| 03C8 | 9C0C | 0410 | STR | D,CV1,CSTRT | INCREMENT ADDRESS | 917 |
| 03CA | B20C | 0411 | CMP | D,CV1,CSTOR | SAVE AS NEW DISPLAY ADDRESS | 918 |
| 03CC | C104 | 03C1 | BRCL | LT,CV2,1 | COMPARE WITH LAST ADDRESS+1 | 919 |
| 03CE | 400C | 0412 | LDR | IS,CV1,0 | DO AGAIN IF NOT FINISHED | 920 |
| 03CF | 9C0C | 0412 | STR | D,CV1,CSTRT | GET A ZERO | 921 |
| 03D1 | C107 | 02FD | BRCL | U,CV1,1 | CLEAR SEQUENTIAL FLAG | 922 |
| 03D3 | | | | | GO GET ANOTHER COMMAND | 923 |
| 03D4 | 001C | | | | | 924 |
| 03D5 | 0D0A | | | | | 925 |
| 03F0 | 0D0A | | | | | 926 |
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ADDRESS OF ROUTINE CALLING CORE

COUNT OF VALUES IN BUFFER TO OUTPUT
OUTPUT BUFFER
CR/LF

DATA AND BUFFERS

CSAVE DS 1
CBCNT DC 28
CBUFF DS 27
DC 00D0A

03/21/77

TIME: 15:22:49

ATAC

| LOC | OBJECT CODE | CARD IMAGE | REG SAVE AREA FOR INTERNAL USE | CARDNUM |
|------|-------------|------------|------------------------------------|---------|
| 03F1 | | CS1 DS 20 | | 945 |
| 0405 | 0003 | CTITLE | | 946 |
| 0406 | 0D0A | DC | | 947 |
| 0407 | 434F | DC | COUNT | 948 |
| 0408 | 5245 | DC | CR/LF | 949 |
| | | | CO | 950 |
| | | | RE | 951 |
| 0409 | 0006 | CBUD | | 952 |
| 040A | | CBUD1 | COUNT | 953 |
| | | | 2 LOCATIONS FOR ADDRESS | 954 |
| 040C | 2020 | DC | BLANKS | 955 |
| 040D | | DS | 2 LOCATIONS FOR CONTENTS | 956 |
| 040F | 0D0A | DC | CR/LF | 957 |
| | | | | 958 |
| 0410 | 0000 | CSTRT | START ADDRESS FOR SEQUENTIAL CORE | 959 |
| 0411 | 0000 | CSTOR | CURRENT ADDRESS FOR STORING IN SEQ | 960 |
| 0412 | 0000 | CSFLG | FLAG FOR SEQUENTIAL CHANGE | 961 |
| | | | | 962 |
| | | | | 963 |
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| LOC | CEJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|-----------------------|---------|
| 050A | E603 09DB | LLC D,WJX1,WJCRO | 55 |
| 050C | D9J2 | ROUT 02,WJXS,0 | 56 |
| 050D | E101 0000 | LDR I,WJXS,CHKFLG1 | 57 |
| 050F | 9C01 09F4 | STR D,WJXS,WJLPK | 58 |
| 0511 | 9C01 09F6 | DAL I,RET,WJJS | 59 |
| 0513 | ED00 08AE | LDR I,WJVV1,WJINS | 60 |
| 0515 | E101 0A02 | BAL I,RET,OUTPUT | 61 |
| 0517 | ED00 0230 | LDR I,WJVV1,WJT | 62 |
| 0519 | E101 09F7 | BAL I,RET,WJ90 | 63 |
| 051B | ED00 07AE | BAL U,WJ02 | 64 |
| 051D | C107 0519 | BRCL | 65 |
| | | ***** | 66 |
| | | ***** | 67 |
| | | ***** | 68 |
| | | ***** | 69 |
| | | ***** | 70 |
| 051F | 2012 | CMP IS,WJV2,1 | 71 |
| 0520 | C105 0519 | BRCL NE,WJ02 | 72 |
| 0522 | 2083 | CMP IS,WJV3,8 | 73 |
| 0523 | C101 0519 | BRCL GT,WJ02 | 74 |
| | | ***** | 75 |
| | | ***** | 76 |
| | | ***** | 77 |
| | | ***** | 78 |
| | | ***** | 79 |
| | | ***** | 80 |
| 0525 | E330 0528 | LDR DX,RET,WJBRC,WJV3 | 81 |
| 0527 | BF07 | BRC R,,RET | 82 |
| | | ***** | 83 |
| | | ***** | 84 |
| | | ***** | 85 |
| | | ***** | 86 |
| | | ***** | 87 |
| 0528 | 0531 | WJBRC DC WJ10 | 88 |
| 0529 | 05AE | DC WJ20 | 89 |
| 052A | 05C6 | DC WJ30 | 90 |
| 052B | 05DE | DC WJ40 | 91 |
| 052C | 0614 | DC WJ50 | 92 |
| 052D | 0657 | DC WJ60 | 93 |
| 052E | C790 | DC WJ70 | 94 |
| 052F | C7A8 | DC WJ80 | 95 |
| 0530 | C502 | DC WJ01 | 96 |
| | | ***** | 97 |
| | | ***** | 98 |
| | | ***** | 99 |
| | | ***** | 100 |
| | | ***** | 101 |
| | | ***** | 102 |
| | | ***** | 103 |
| 0531 | E101 0A4D | WJ10 LDR I,WJV1,WJFB | 104 |
| 0533 | ED00 07AE | BAL I,RET,WJ90 | 105 |
| 0535 | C107 0531 | BRCL U,WJ10 | 106 |
| 0537 | ED00 07CC | BAL I,RET,WJ91 | 107 |

LOAD "ADDRESS ON"
 ENABLE RECEIVER/TURN ON INTERFACE
 CLEAR REGISTER
 CLEAR FLAG
 ZERO WJS COUNTER
 SEND INITIAL CONTROL WORD TO RCVR
 GET ADDRESS OF INSTRUCTION BUFFER
 OUTPUT INSTRUCTIONS TO CRT
 GET ADDRESS OF TITLE BUFFER
 OUTPUT TITLE AND GET ENTRY
 ILLEGAL ENTRY

 COMPARE WITH ONE
 WILL ONLY ACCEPT ONE CHAR
 COMPARE WITH MAX VALUE
 ENTRY OUT OF RANGE

 GET ADDRESS FOR BRANCH FROM TABLE
 GO PROCESS ACCORDING TO COMMAND

 0=SET UP TENTATIVE WORD
 1=DISPLAY TENTATIVE CONTROL WORD
 2=DISPLAY CONTROL WORD
 3=DISPLAY LAST RECEIVED WORD
 4=ENTER TENTATIVE WORD AS NEW CONTROL
 5=SCAN
 6=RECEIVE CONTROL WORD FROM RCVR
 7=DONE
 8=REINITIALIZE

 GET ADDRESS OF FREQUENCY TITLE
 OUTPUT TITLE AND GET ENTRY
 ILLEGAL ENTRY
 MAKE SURE FREQUENCY IS LEGAL

| ATAC | LOC | OBJECT CODE | CARD | IMAGE | CARDNUM |
|------|------|-------------|------|--------------------------------------|---------|
| 0539 | 053B | C107 0531 | BRCL | U, WJ10 | 108 |
| 0539 | 053D | 9C03 09D0 | STR | D, WJ10, WJ10 | 109 |
| 0539 | 053D | 9C04 09D1 | STR | D, WJ10, WJ10 | 110 |
| | | | | ILLEGAL FREQUENCY | 111 |
| | | | | STORE TENTATIVE FREQUENCY {LOWER} | 112 |
| | | | | STORE TENTATIVE FREQUENCY {UPPER} | 113 |
| 053F | 0541 | E101 0A89 | LDR | I, WJ11, WJ10 | 114 |
| 0541 | 0543 | E100 07AE | BAL | I, RET, WJ10 | 115 |
| 0543 | 0545 | C107 053F | BRCL | U, WJ11 | 116 |
| 0545 | 0546 | 2073 | CHP | IS, WJ13, 7 | 117 |
| 0546 | 0548 | C101 053P | BRCL | GT, WJ11 | 118 |
| 0548 | 054A | 9C03 09D2 | STR | D, WJ13, WJ10 | 119 |
| 054A | 054C | E101 0004 | LDR | I, WJ11, 04 | 120 |
| 054C | 054E | 9C01 09D4 | STR | D, WJ11, WJ10 | 121 |
| 054E | 0550 | E101 5500 | LDR | I, WJ11, 05500 | 122 |
| 0550 | 0552 | 9C01 09D3 | STR | D, WJ11, WJ10 | 123 |
| 0552 | 0554 | 2033 | CHP | IS, WJ13, 3 | 124 |
| 0554 | 0556 | C105 056E | BRCL | NE, WJ13 | 125 |
| | | | | NOT VARIABLE BFO, USE DEFAULT FREQUE | 126 |
| 0555 | 0557 | E101 0AB3 | LDR | I, WJ11, WJ10 | 127 |
| 0557 | 0559 | E100 07AE | BAL | I, RET, WJ10 | 128 |
| 0559 | 055B | C107 0555 | BRCL | U, WJ12 | 129 |
| 055B | 055C | 2062 0555 | CHP | IS, WJ12, 6 | 130 |
| 055C | 055E | E833 | CHP | NE, WJ12 | 131 |
| 055E | 055F | 2044 | CHP | RL, WJ13, 4 | 132 |
| 055F | 0560 | C105 0555 | BRCL | IS, WJ14, 04 | 133 |
| 0560 | 0562 | B103 4500 | CHP | NE, WJ12 | 134 |
| 0562 | 0564 | C104 0555 | CHP | I, WJ13, 04500 | 135 |
| 0564 | 0566 | B103 6500 | CHP | IF, WJ12, 06500 | 136 |
| 0566 | 0568 | C101 0555 | BRCL | IF, WJ13, 06500 | 137 |
| 0568 | 056A | 9C03 09D3 | STR | GT, WJ12 | 138 |
| 056A | 056C | 9C04 09D4 | STR | D, WJ13, WJ10 | 139 |
| | | | | SAVE TENTATIVE BFO FREQUENCY {LOWER} | 140 |
| | | | | SAVE TENTATIVE BFO FREQUENCY {UPPER} | 141 |
| 056E | 0570 | E101 0A53 | LDR | I, WJ11, WJ10 | 142 |
| 0570 | 0572 | E100 07AE | BAL | I, RET, WJ10 | 143 |
| 0572 | 0574 | C107 056E | BRCL | U, WJ13 | 144 |
| 0574 | 0576 | 2033 | CHP | IS, WJ13, 3 | 145 |
| 0576 | 0578 | C101 056E | BRCL | GT, WJ13 | 146 |
| 0578 | 057A | 2013 | CHP | IS, WJ13, 1 | 147 |
| 057A | 057C | C102 056E | BRCL | EQ, WJ13 | 148 |
| 057C | 057E | E201 09D2 | LDR | D, WJ13, WJ10 | 149 |
| 057E | 0580 | 2041 | CHP | IS, WJ11, 4 | 150 |
| 0580 | 0582 | C105 0582 | BRCL | NE, WJ13 | 151 |
| 0582 | 0584 | 2033 | CHP | IS, WJ13, 0 | 152 |
| 0584 | 0586 | C102 056E | BRCL | EQ, WJ13 | 153 |
| 0586 | 0588 | 9C03 09D5 | STR | D, WJ13, WJ10 | 154 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 155 |
| | | | | SAVE TENTATIVE GAIN MODE | 156 |
| 0588 | 0590 | C102 056E | BRCL | EQ, WJ13 | 157 |
| 0590 | 0592 | 9C03 09D5 | STR | D, WJ13, WJ10 | 158 |
| | | | | SAVE TENTATIVE GAIN MODE | 159 |
| 0592 | 0594 | C102 056E | BRCL | EQ, WJ13 | 160 |
| 0594 | 0596 | 9C03 09D5 | STR | D, WJ13, WJ10 | 161 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 162 |
| | | | | SAVE TENTATIVE GAIN MODE | 163 |
| 0596 | 0598 | C102 056E | BRCL | EQ, WJ13 | 164 |
| 0598 | 059A | 9C03 09D5 | STR | D, WJ13, WJ10 | 165 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 166 |
| | | | | SAVE TENTATIVE GAIN MODE | 167 |
| 059A | 059C | C102 056E | BRCL | EQ, WJ13 | 168 |
| 059C | 059E | 9C03 09D5 | STR | D, WJ13, WJ10 | 169 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 170 |
| | | | | SAVE TENTATIVE GAIN MODE | 171 |
| 059E | 0600 | E101 0A53 | LDR | I, WJ11, WJ10 | 172 |
| 0600 | 0602 | E100 07AE | BAL | I, RET, WJ10 | 173 |
| 0602 | 0604 | C107 056E | BRCL | U, WJ13 | 174 |
| 0604 | 0606 | 2033 | CHP | IS, WJ13, 3 | 175 |
| 0606 | 0608 | C101 056E | BRCL | GT, WJ13 | 176 |
| 0608 | 0610 | 2013 | CHP | IS, WJ13, 1 | 177 |
| 0610 | 0612 | C102 056E | BRCL | EQ, WJ13 | 178 |
| 0612 | 0614 | E201 09D2 | LDR | D, WJ13, WJ10 | 179 |
| 0614 | 0616 | 2041 | CHP | IS, WJ11, 4 | 180 |
| 0616 | 0618 | C105 0582 | BRCL | NE, WJ13 | 181 |
| 0618 | 0620 | 2033 | CHP | IS, WJ13, 0 | 182 |
| 0620 | 0622 | C102 056E | BRCL | EQ, WJ13 | 183 |
| 0622 | 0624 | 9C03 09D5 | STR | D, WJ13, WJ10 | 184 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 185 |
| | | | | SAVE TENTATIVE GAIN MODE | 186 |
| 0624 | 0626 | C102 056E | BRCL | EQ, WJ13 | 187 |
| 0626 | 0628 | 9C03 09D5 | STR | D, WJ13, WJ10 | 188 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 189 |
| | | | | SAVE TENTATIVE GAIN MODE | 190 |
| 0628 | 0630 | C102 056E | BRCL | EQ, WJ13 | 191 |
| 0630 | 0632 | 9C03 09D5 | STR | D, WJ13, WJ10 | 192 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 193 |
| | | | | SAVE TENTATIVE GAIN MODE | 194 |
| 0632 | 0634 | C102 056E | BRCL | EQ, WJ13 | 195 |
| 0634 | 0636 | 9C03 09D5 | STR | D, WJ13, WJ10 | 196 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 197 |
| | | | | SAVE TENTATIVE GAIN MODE | 198 |
| 0636 | 0638 | C102 056E | BRCL | EQ, WJ13 | 199 |
| 0638 | 0640 | 9C03 09D5 | STR | D, WJ13, WJ10 | 200 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 201 |
| | | | | SAVE TENTATIVE GAIN MODE | 202 |
| 0640 | 0642 | C102 056E | BRCL | EQ, WJ13 | 203 |
| 0642 | 0644 | 9C03 09D5 | STR | D, WJ13, WJ10 | 204 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 205 |
| | | | | SAVE TENTATIVE GAIN MODE | 206 |
| 0644 | 0646 | C102 056E | BRCL | EQ, WJ13 | 207 |
| 0646 | 0648 | 9C03 09D5 | STR | D, WJ13, WJ10 | 208 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 209 |
| | | | | SAVE TENTATIVE GAIN MODE | 210 |
| 0648 | 0650 | C102 056E | BRCL | EQ, WJ13 | 211 |
| 0650 | 0652 | 9C03 09D5 | STR | D, WJ13, WJ10 | 212 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 213 |
| | | | | SAVE TENTATIVE GAIN MODE | 214 |
| 0652 | 0654 | C102 056E | BRCL | EQ, WJ13 | 215 |
| 0654 | 0656 | 9C03 09D5 | STR | D, WJ13, WJ10 | 216 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 217 |
| | | | | SAVE TENTATIVE GAIN MODE | 218 |
| 0656 | 0658 | C102 056E | BRCL | EQ, WJ13 | 219 |
| 0658 | 0660 | 9C03 09D5 | STR | D, WJ13, WJ10 | 220 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 221 |
| | | | | SAVE TENTATIVE GAIN MODE | 222 |
| 0660 | 0662 | C102 056E | BRCL | EQ, WJ13 | 223 |
| 0662 | 0664 | 9C03 09D5 | STR | D, WJ13, WJ10 | 224 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 225 |
| | | | | SAVE TENTATIVE GAIN MODE | 226 |
| 0664 | 0666 | C102 056E | BRCL | EQ, WJ13 | 227 |
| 0666 | 0668 | 9C03 09D5 | STR | D, WJ13, WJ10 | 228 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 229 |
| | | | | SAVE TENTATIVE GAIN MODE | 230 |
| 0668 | 0670 | C102 056E | BRCL | EQ, WJ13 | 231 |
| 0670 | 0672 | 9C03 09D5 | STR | D, WJ13, WJ10 | 232 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 233 |
| | | | | SAVE TENTATIVE GAIN MODE | 234 |
| 0672 | 0674 | C102 056E | BRCL | EQ, WJ13 | 235 |
| 0674 | 0676 | 9C03 09D5 | STR | D, WJ13, WJ10 | 236 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 237 |
| | | | | SAVE TENTATIVE GAIN MODE | 238 |
| 0676 | 0678 | C102 056E | BRCL | EQ, WJ13 | 239 |
| 0678 | 0680 | 9C03 09D5 | STR | D, WJ13, WJ10 | 240 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 241 |
| | | | | SAVE TENTATIVE GAIN MODE | 242 |
| 0680 | 0682 | C102 056E | BRCL | EQ, WJ13 | 243 |
| 0682 | 0684 | 9C03 09D5 | STR | D, WJ13, WJ10 | 244 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 245 |
| | | | | SAVE TENTATIVE GAIN MODE | 246 |
| 0684 | 0686 | C102 056E | BRCL | EQ, WJ13 | 247 |
| 0686 | 0688 | 9C03 09D5 | STR | D, WJ13, WJ10 | 248 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 249 |
| | | | | SAVE TENTATIVE GAIN MODE | 250 |
| 0688 | 0690 | C102 056E | BRCL | EQ, WJ13 | 251 |
| 0690 | 0692 | 9C03 09D5 | STR | D, WJ13, WJ10 | 252 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 253 |
| | | | | SAVE TENTATIVE GAIN MODE | 254 |
| 0692 | 0694 | C102 056E | BRCL | EQ, WJ13 | 255 |
| 0694 | 0696 | 9C03 09D5 | STR | D, WJ13, WJ10 | 256 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 257 |
| | | | | SAVE TENTATIVE GAIN MODE | 258 |
| 0696 | 0698 | C102 056E | BRCL | EQ, WJ13 | 259 |
| 0698 | 0700 | 9C03 09D5 | STR | D, WJ13, WJ10 | 260 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 261 |
| | | | | SAVE TENTATIVE GAIN MODE | 262 |
| 0700 | 0702 | C102 056E | BRCL | EQ, WJ13 | 263 |
| 0702 | 0704 | 9C03 09D5 | STR | D, WJ13, WJ10 | 264 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 265 |
| | | | | SAVE TENTATIVE GAIN MODE | 266 |
| 0704 | 0706 | C102 056E | BRCL | EQ, WJ13 | 267 |
| 0706 | 0708 | 9C03 09D5 | STR | D, WJ13, WJ10 | 268 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 269 |
| | | | | SAVE TENTATIVE GAIN MODE | 270 |
| 0708 | 0710 | C102 056E | BRCL | EQ, WJ13 | 271 |
| 0710 | 0712 | 9C03 09D5 | STR | D, WJ13, WJ10 | 272 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 273 |
| | | | | SAVE TENTATIVE GAIN MODE | 274 |
| 0712 | 0714 | C102 056E | BRCL | EQ, WJ13 | 275 |
| 0714 | 0716 | 9C03 09D5 | STR | D, WJ13, WJ10 | 276 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 277 |
| | | | | SAVE TENTATIVE GAIN MODE | 278 |
| 0716 | 0718 | C102 056E | BRCL | EQ, WJ13 | 279 |
| 0718 | 0720 | 9C03 09D5 | STR | D, WJ13, WJ10 | 280 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 281 |
| | | | | SAVE TENTATIVE GAIN MODE | 282 |
| 0720 | 0722 | C102 056E | BRCL | EQ, WJ13 | 283 |
| 0722 | 0724 | 9C03 09D5 | STR | D, WJ13, WJ10 | 284 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 285 |
| | | | | SAVE TENTATIVE GAIN MODE | 286 |
| 0724 | 0726 | C102 056E | BRCL | EQ, WJ13 | 287 |
| 0726 | 0728 | 9C03 09D5 | STR | D, WJ13, WJ10 | 288 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 289 |
| | | | | SAVE TENTATIVE GAIN MODE | 290 |
| 0728 | 0730 | C102 056E | BRCL | EQ, WJ13 | 291 |
| 0730 | 0732 | 9C03 09D5 | STR | D, WJ13, WJ10 | 292 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 293 |
| | | | | SAVE TENTATIVE GAIN MODE | 294 |
| 0732 | 0734 | C102 056E | BRCL | EQ, WJ13 | 295 |
| 0734 | 0736 | 9C03 09D5 | STR | D, WJ13, WJ10 | 296 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 297 |
| | | | | SAVE TENTATIVE GAIN MODE | 298 |
| 0736 | 0738 | C102 056E | BRCL | EQ, WJ13 | 299 |
| 0738 | 0740 | 9C03 09D5 | STR | D, WJ13, WJ10 | 300 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 301 |
| | | | | SAVE TENTATIVE GAIN MODE | 302 |
| 0740 | 0742 | C102 056E | BRCL | EQ, WJ13 | 303 |
| 0742 | 0744 | 9C03 09D5 | STR | D, WJ13, WJ10 | 304 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 305 |
| | | | | SAVE TENTATIVE GAIN MODE | 306 |
| 0744 | 0746 | C102 056E | BRCL | EQ, WJ13 | 307 |
| 0746 | 0748 | 9C03 09D5 | STR | D, WJ13, WJ10 | 308 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 309 |
| | | | | SAVE TENTATIVE GAIN MODE | 310 |
| 0748 | 0750 | C102 056E | BRCL | EQ, WJ13 | 311 |
| 0750 | 0752 | 9C03 09D5 | STR | D, WJ13, WJ10 | 312 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 313 |
| | | | | SAVE TENTATIVE GAIN MODE | 314 |
| 0752 | 0754 | C102 056E | BRCL | EQ, WJ13 | 315 |
| 0754 | 0756 | 9C03 09D5 | STR | D, WJ13, WJ10 | 316 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 317 |
| | | | | SAVE TENTATIVE GAIN MODE | 318 |
| 0756 | 0758 | C102 056E | BRCL | EQ, WJ13 | 319 |
| 0758 | 0760 | 9C03 09D5 | STR | D, WJ13, WJ10 | 320 |
| | | | | MAKE SURE GAIN MODE NOT HOLD AGC | 321 |
| | | | | SAVE TENTATIVE GAIN MODE | 322 |
| 0760 | 0762 | C102 056E | BRCL | EQ, WJ13 | 323 |
| 0762 | 0764 | 9C03 09D5 | STR | D, WJ13, WJ10 | 324 |
| | | | | MAKE SURE GAIN MODE NOT | |

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|------|-----------|---|-----------------|--------------------------------------|-----|
| 0584 | E201 09D2 | . | D, WJ11, WJTD1 | GET TENTATIVE DETECT MODE | 161 |
| 0586 | 2041 | | IS, WJ11, 4 | COMPARE WITH IS | 162 |
| 0587 | C104 058F | | LT, WJ14 | NOT SIDE BAND-BRANCH | 163 |
| 0589 | 2061 058F | | IS, WJ11, 6 | COMPARE WITH USE | 164 |
| 058A | C101 058F | | GT, WJ14 | NOT SIDE BAND-BRANCH | 165 |
| 058C | 4043 | | IS, WJ13, 4 | LOAD DEFAULT IF BANDWIDTH | 166 |
| 058D | C107 059B | | U, WJ14, 1 | SKIP IF BANDWIDTH | 167 |
| 058F | E101 0A6D | | I, WJ11, WJIFB | GET ADDRESS OF IF BANDWIDTH TITLE | 168 |
| 0591 | ED00 07AE | | I, RET, WJ90 | OUTPUT TITLE AND GET ENTRY | 169 |
| 0593 | C107 058F | | U, WJ14 | ILLEGAL ENTRY | 170 |
| 0595 | 2043 | | IS, WJ13, 4 | COMPARE WITH MAX VALUE | 171 |
| 0596 | C101 058F | | GT, WJ14 | ILLEGAL ENTRY | 172 |
| 0598 | 2013 | | IS, WJ13, 1 | COMPARE WITH MIN VALUE | 173 |
| 0599 | C104 058F | | LT, WJ14 | ILLEGAL ENTRY | 174 |
| 059B | 9C03 09D7 | | D, WJ13, WJ1F | SAVE TENTATIVE IF BANDWIDTH | 175 |
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| 059D | E101 0ACA | | I, WJ11, WJ1FGB | GET ADDRESS OF RF GAIN TITLE | 181 |
| 059F | ED00 07AE | | I, RET, WJ90 | OUTPUT TITLE AND GET ENTRY | 182 |
| 05A1 | C107 059D | | U, WJ15 | ILLEGAL ENTRY | 183 |
| 05A3 | 2032 | | IS, WJ12, 3 | COMPARE WITH MAX COUNT | 184 |
| 05A4 | C101 059D | | GT, WJ15 | ILLEGAL ENTRY | 185 |
| 05A6 | B103 0100 | | I, WJ13, 0100 | COMPARE WITH MAX VALUE | 186 |
| 05A8 | C101 059D | | GT, WJ15 | ILLEGAL ENTRY | 187 |
| 05AA | 9C03 09D6 | | D, WJ13, WJ1FRG | SAVE TENTATIVE RF GAIN | 188 |
| | | | | | 189 |
| 05AC | C107 0519 | | BRCL U, WJ02 | GO GET ANOTHER COMMAND | 190 |
| | | | | | 191 |
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| 05AE | E202 09D1 | | D, WJ12, WJ1FU | GET UPPER OF TENTATIVE FREQUENCY | 199 |
| 05E0 | E201 09D0 | | I, WJ11, WJ1FL | GET LOWER OF TENTATIVE FREQUENCY | 200 |
| 05E2 | ED00 07D9 | | I, RET, WJ92 | PUT FREQUENCY IN BUFFER AND DISPLAY | 201 |
| 05E4 | E201 09D5 | | D, WJ11, WJ1G1 | GET TENTATIVE GAIN MODE | 202 |
| 05E6 | ED00 09D7 | | D, WJ12, WJ1IF | GET TENTATIVE IF BANDWIDTH | 203 |
| 05E8 | ED00 0801 | | I, RET, WJ93 | OUTPUT GAIN MODE AND IF BANDWIDTH | 204 |
| 05EA | E201 09D2 | | D, WJ11, WJ1DM | GET TENTATIVE DETECT MODE | 205 |
| 05EC | E202 09D3 | | D, WJ12, WJ1BL | GET TENTATIVE BFO FREQUENCY (LOWER) | 206 |
| 05EE | ED00 0820 | | I, RET, WJ94 | OUTPUT DETECT MODE AND BFO FREQUENCY | 207 |
| 05C0 | E201 09D6 | | D, WJ11, WJ1FRG | GET TENTATIVE RF GAIN | 208 |
| 05C2 | ED00 084A | | I, RET, WJ95 | OUTPUT RF GAIN | 209 |
| 05C4 | C107 0519 | | U, WJ02 | DONE | 210 |
| | | | | | 211 |
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|------|-----------|-------------------------------------------------------|-----------------|---------|
| 0658 | 9C01 09F0 | INITIALIZE PASS COUNT | D, WJVI, WJSCNT | 320 |
| 065A | E101 0B97 | GET ADDRESS OF SCAN TITLE | I, WJVI, WJSCAN | 321 |
| 065C | ED00 0230 | OUTPUT SCAN TITLE | I, RET, OUTPUT | 322 |
| 065E | | SPACE FOR PATCHES | DS 10 | 323 |
| | | | | 324 |
| | | | | 325 |
| | | | | 326 |
| 0668 | E101 0B9C | OUTPUT TITLE AND GET LOWER FREQUENCY LIMIT | I, WJVI, WJSFS | 327 |
| 066A | ED00 07AE | GET ADDRESS OF START FREQUENCY TITLE | I, RET, WJ90 | 328 |
| 066C | C107 0668 | ILLEGAL ENTRY | U, WJ601 | 329 |
| 066E | ED00 07CC | MAKE SURE FREQ IS IN LEGAL BOUNDS | I, RET, WJ91 | 330 |
| 0670 | C107 06ED | ILLEGAL ENTRY | U, WJ601 | 331 |
| 0672 | 9C03 09ED | SAVE LOWER LIMIT (LOWER) | D, WJVI, WJSFLL | 332 |
| 0674 | 9C04 09EC | SAVE LOWER LIMIT (UPPER) | D, WJV4, WJSFLL | 333 |
| 0676 | | SPACE FOR PATCHES | DS 10 | 334 |
| | | | | 335 |
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| 0680 | E101 0BA7 | OUTPUT TITLE AND GET UPPER FREQUENCY LIMIT | I, WJVI, WJSFE | 338 |
| 0682 | ED00 07AE | GET ADDRESS OF END FREQ TITLE | I, RET, WJ90 | 339 |
| 0684 | C107 0680 | ILLEGAL ENTRY | U, WJ602 | 340 |
| 0686 | ED00 07CC | MAKE SURE FREQ IS IN LEGAL BOUNDS | I, RET, WJ91 | 341 |
| 0688 | C107 0680 | ILLEGAL ENTRY | U, WJ602 | 342 |
| 068A | 9C03 09EB | SAVE UPPER LIMIT (LOWER) | D, WJVI, WJSFUL | 343 |
| 068C | 9C04 09EA | SAVE UPPER LIMIT (UPPER) | D, WJV4, WJSFUL | 344 |
| 068E | | SPACE FOR PATCHES | DS 10 | 345 |
| | | | | 346 |
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| 0698 | E205 09EC | GET LOWER LIMIT (UPPER) | D, WJV5, WJSFLL | 349 |
| 069A | B054 0668 | COMPARE UPPER AND LOWER LIMITS (UPPER) | R, WJV4, WJV5 | 350 |
| 069B | C104 0668 | UPPER LIMIT LESS THAN LOWER | LT, WJ601 | 351 |
| 069D | E205 09ED | NO NEED TO CHECK FURTHER | GT, WJ603 | 352 |
| 069F | E205 09ED | GET LOWER LIMIT (LOWER) | D, WJV5, WJSFLL | 353 |
| 06A1 | B053 0668 | COMPARE UPPER AND LOWER LIMITS (LOWER) | R, WJV3, WJV5 | 354 |
| 06A2 | C106 0668 | LESS OR EQUAL, TRY AGAIN | LE, WJ601 | 355 |
| 06A4 | | SPACE FOR PATCHES | DS 10 | 356 |
| | | | | 357 |
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| 06AE | E101 0BB1 | OUTPUT TITLE AND GET FREQUENCY INCREMENT (8000HZ MAX) | I, WJVI, WJSFI | 360 |
| 06E0 | ED00 07AE | GET ADDRESS OF FREQ INC TITLE | I, RET, WJ90 | 361 |
| 06E2 | C107 06AE | ILLEGAL ENTRY | U, WJ603 | 362 |
| 06E4 | E833 | POSITION INCREMENT | SHD | 363 |
| 06E5 | 2042 | COMPARE COUNT WITH MAX | IS, WJV3, 4 | 364 |
| 06E6 | C101 06AE | ILLEGAL - TOO LARGE | IS, WJV2, 4 | 365 |
| 06E8 | B103 0800 | COMPARE WITH MAX INCREMENT | GT, WJ603 | 366 |
| 06EA | C101 06AE | ILLEGAL - TOO LARGE | GT, WJ603 | 367 |
| 06EC | 2013 | COMPARE WITH MIN INCREMENT | IS, WJV3, 1 | 368 |
| 06ED | C104 06AE | ILLEGAL - TOO SMALL | IS, WJ603 | 369 |
| 06EF | 9C03 09EE | SAVE INCREMENT | LT, WJ603 | 370 |
| 06C1 | | SPACE FOR PATCHES | DS 10 | 371 |
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| LOC | OBJECT CODE | CARD IMAGE | OUTPUT TITLE AND GET SIGNAL STRENGTH | GET ADDRESS OF SIGNAL STRENGTH TITLE | CARDNUM |
|------|-------------|------------|--------------------------------------|--------------------------------------|---------|
| 06C5 | E101 0BEE | LDR | I, WJ604 | GET ADDRESS OF SIGNAL STRENGTH TITLE | 373 |
| 06C6 | ED00 07AE | BAL | I, WJ604 | OUTPUT TILE AND GET ENTRY | 374 |
| 06C7 | C107 06CB | BCL | I, WJ604 | ILLEGAL ENTRY | 375 |
| 06D1 | B103 0100 | CMF | I, WJ604 | COMPARE WITH MAX VALUE | 376 |
| 06D3 | C101 06CB | BCL | I, WJ604 | ILLEGAL - TOO LARGE | 377 |
| 06D5 | 2032 | CHP | I, WJ604 | COMPARE COUNT WITH MAX | 378 |
| 06D6 | C101 06CB | BCL | I, WJ604 | ILLEGAL - TOO LARGE | 379 |
| 06D8 | E032 09EE | LDR | R, WJ604 | PUT SIGNAL STRENGTH IN REG 2 | 380 |
| 06D9 | ED00 09EE | BAL | I, WJ604 | CONVERT BCD TO HEX | 381 |
| 06E8 | C001 007F | MUL | I, WJ604 | MULTIPLY BY 127 | 382 |
| 06DD | 6321 | ADD | I, WJ604 | ROUND | 383 |
| 06DE | A443 | LDR | I, WJ604 | SET UP DIVISOR | 384 |
| 06DF | FC31 | DIV | I, WJ604 | DIVIDE BY 100 | 385 |
| 06E0 | A102 007F | AND | I, WJ604 | CLEAR ALL BUT VALUE WANTED | 386 |
| 06E2 | 9C02 09EF | STR | D, WJ604 | STORE DESIRED SIGNAL STRENGTH | 387 |
| 06E4 | | DS | 16 | SPACE FOR PATCHES | 388 |
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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|---------------------------|---------|
| 072C | E201 09EB | LDR D, WJVI, WJSFUL | 426 |
| 072E | E202 09EA | LDR D, WJV2, WJSF00 | 427 |
| 0730 | E062 | CMP R, WJV2, WJV6 | 428 |
| 0731 | C101 06F2 | BRCL GT, WJ606 | 429 |
| 0733 | C102 073F | BRCL EQ, WJ608 | 430 |
| 0735 | E201 09F0 | LDR D, WJV1, WJSCNT | 431 |
| 0737 | E011 | ADD IS, WJV1, 100 | 432 |
| 0738 | E264 | CHP IS, WJV1, 100 | 433 |
| 0739 | C101 075E | BRCL GT, WJ610 | 434 |
| 073B | 9C01 09F0 | STR D, WJV1, WJSCNT | 435 |
| 073D | C107 06EE | BRCL U, WJ605 | 436 |
| 073P | B051 | CMP R, WJV1, WJV5 | 437 |
| 0740 | C104 0735 | BRCL LT, WJ607 | 438 |
| 0742 | C107 06F2 | BRCL U, WJ606 | 439 |
| 0744 | | DS 10 | 440 |
| | | . FIND | 441 |
| | | . NO FINL - TELL OPERATOR | 442 |
| 074E | BC11 09E0 | LDRM D, WJV1, WJREFL, 2 | 443 |
| 0750 | 9C11 09D8 | STRM D, WJV1, WJCPL, 2 | 444 |
| 0752 | C107 05DE | BRCL U, WJ40 | 445 |
| 0754 | | DS 10 | 446 |
| | | . NO FINL - TELL OPERATOR | 447 |
| | | . NO FINL - TELL OPERATOR | 448 |
| 075E | BC11 09E0 | LDRM D, WJV1, WJREFL, 2 | 449 |
| 0760 | 9C11 09D8 | STRM D, WJV1, WJCPL, 2 | 450 |
| 0762 | E101 0ECA | LDR I, WJV1, WJSNF | 451 |
| 0764 | E000 0230 | BAL I, RET, OUTPUT | 452 |
| 0766 | C107 0519 | BRCL U, WJ02 | 453 |
| 0768 | | DS 40 | 454 |
| | | . NO FINL - TELL OPERATOR | 455 |
| | | . NO FINL - TELL OPERATOR | 456 |
| | | . NO FINL - TELL OPERATOR | 457 |
| | | . NO FINL - TELL OPERATOR | 458 |
| | | . NO FINL - TELL OPERATOR | 459 |
| | | . NO FINL - TELL OPERATOR | 460 |
| | | . NO FINL - TELL OPERATOR | 461 |
| | | . NO FINL - TELL OPERATOR | 462 |
| | | . NO FINL - TELL OPERATOR | 463 |
| | | . NO FINL - TELL OPERATOR | 464 |
| 0790 | E101 0001 | LDR I, WJV1, 01 | 465 |
| 0792 | 9C01 09F4 | STR D, WJV1, CHKFLG1 | 466 |
| 0794 | E000 08E1 | BAL I, RET, WJR | 467 |
| 0796 | E101 0000 | LDR I, WJV1, 0 | 468 |
| 0798 | 9C01 09F4 | STR D, WJV1, CHKFLG1 | 469 |
| 079A | C107 05DE | BRCL U, WJ40 | 470 |
| 079C | C107 0519 | BRCL U, WJ02 | 471 |
| 079E | | DS 10 | 472 |
| | | . NO FINL - TELL OPERATOR | 473 |
| | | . NO FINL - TELL OPERATOR | 474 |
| | | . NO FINL - TELL OPERATOR | 475 |
| | | . NO FINL - TELL OPERATOR | 476 |
| | | . NO FINL - TELL OPERATOR | 477 |
| | | . NO FINL - TELL OPERATOR | 478 |

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*****
WJ80      LLC      D,WJV1,WJCRF      LOAD "ADDRESS OFF"
          ROUT      02,WJV1          TURN OFF INTERFACE
          LDR       D,RET,WJRET      LOAD RETURN ADDRESS
          BRC       R,7,RET         RETURN TO CALLER

*****
ROUTINE TO OUTPUT BUFFER AND GET ENTRY FROM KEYBOARD
ENTRY: WJV1 ADDRESS OF BUFFER TO BE OUTPUT
EXIT: WJV2 NUMBER OF CHARACTERS ENTERED
      WJV3 ENTRY (LOWER) BCD
      WJV4 ENTRY (UPPER) BCD
      RETURN FOR ILLEGAL ENTRY
      RETURN#2 FOR ILLEGAL ENTRY
*****
WJ90      STR      D,RET,WJ90R      SAVE THE RETURN ADDRESS
          BAL      I,RET,OUTPUT    OUTPUT BUFFER
          BAL      I,RET,KEYMR     GET INPUT FROM KEYBOARD
          LDR      IS,WJV3,0       CLEAR REGISTER
          LDR      IS,WJV4,0       CLEAR REGISTER
          LDR      IS,WJV5,0       CLEAR REGISTER
          LDR      RX,WJV2,WJV5,WJV1 GET COUNT FROM KEYMR
          LDR      R,WJV7,WJV2     SET UP INDEX FOR LOOP
          LDR      D,RET,WJ90R     GET RETURN ADDRESS
          ADD      IS,WJV7,-1       DECREMENT COUNT
          BRC      R,4,RET          ILLEGAL IF NEG NOTHING ENTERED
          BRC      R,4,RET          INCREMENT BUFFER POINTER
          LDR      RX,WJV6,WJV5,WJV1 GET ONE CHARACTER
          CMP      IS,WJV6,030     COMPARE CHAR WITH ASCII ZERO
          BRC      R,4,RET          ILLEGAL CHARACTER IS LESS
          CMP      IS,WJV6,039     COMPARE WITH ASCII 9
          BRC      R,1,RET          ILLEGAL CHARACTER IS GREATER
          AND      I,WJV6,OF       CLEAR UPPER 12 BITS
          SHD      LL,WJV3,4       POSITION ENTRY FOR NEW CHARACTER
          LDR      R,WJV3,WJV6     OR IN NEW CHARACTER
          ADD      IS,WJV7,-1       DECREMENT COUNT
          BRC      NN,WJ90,1       KEEP GOING IF MORE CHARACTERS
          BRC      IS,RET,2        INCREMENT RETURN ADDRESS
          BRC      R,7,RET         LEGAL RETURN

*****
ROUTINE TO CHECK A FREQUENCY ENTRY AND MAKE SURE IT IS IN WJ
FREQUENCY LIMITS
ENTRY: WJV2 NUMBER OF CHARACTERS ENTERED
      WJV3 FREQUENCY (LOWER) BCD,1 HZ RESOLUTION
*****

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|------|-------------|------------|---------|
| 07F7 | A442 | IOR | 585 |
| 07F8 | 9C02 | STR | 586 |
| 07FA | E101 | LDR | 587 |
| 07FC | ED00 | BAL | 588 |
| 07FE | E200 | BRC | 589 |
| 0800 | BF07 | BRC | 590 |
| | | | 591 |
| | | | 592 |
| | | | 593 |
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| | | | 600 |
| 0801 | 9C00 | STR | 601 |
| 0803 | 9C02 | STR | 602 |
| 0805 | 9C01 | STR | 603 |
| 0807 | E101 | LDR | 604 |
| 0809 | ED00 | BAL | 605 |
| 080B | E202 | BRC | 606 |
| 080D | E103 | LDR | 607 |
| 080F | 5321 | BAL | 608 |
| 0810 | ED00 | BAL | 609 |
| 0812 | E101 | LDR | 610 |
| 0814 | ED00 | BAL | 611 |
| 0816 | E202 | BRC | 612 |
| 0818 | E103 | LDR | 613 |
| 081A | 5321 | BAL | 614 |
| 081B | ED00 | BAL | 615 |
| 081D | E200 | BRC | 616 |
| 081F | BF07 | BRC | 617 |
| | | | 618 |
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| | | | 627 |
| 0820 | 9C00 | STR | 628 |
| 0822 | 9C01 | STR | 629 |
| 0824 | 9C02 | STR | 630 |
| 0826 | E101 | LDR | 631 |
| 0828 | E200 | BAL | 632 |
| 082A | E202 | BRC | 633 |
| 082C | E103 | LDR | 634 |
| 082E | 5321 | BAL | 635 |
| 082F | ED00 | BAL | 636 |
| 0831 | E201 | BRC | 637 |

CONVERT TO ASCII
 PUT IN DISPLAY EUFFER
 GET ADDRESS OF OUTPUT BUFFER
 OUTPUT BUFFER
 GET RETURN ADDRESS
 RETURN TO CALLER

 ROUTINE TO DISPLAY GAIN MODE AND IF BANDWIDTH
 WJ1 GAIN MODE IN DISPLAY FORMAT
 WJ2 IF BANDWIDTH IN DISPLAY FORMAT

 SAVE RETURN ADDRESS
 SAVE IF BANDWIDTH
 SAVE GAIN MODE
 GET ADDRESS OF EUFFER TO OUTPUT
 OUTPUT BUFFER
 PUT GAIN MODE IN REG 2
 GET ADDRESS OF GAIN MODE TABLE
 OUTPUT BUFFER
 GET ADDRESS OF EUFFER TO OUTPUT
 OUTPUT BUFFER
 GET ADDRESS OF EUFFER TO OUTPUT
 OUTPUT BUFFER
 GET IF BANDWIDTH
 GET ADDRESS OF IF BANDWIDTH TABLE
 OUTPUT BUFFER
 GET ADDRESS OF EUFFER TO OUTPUT
 OUTPUT IF BANDWIDTH BUFFER
 GET RETURN ADDRESS
 RETURN TO CALLER

 ROUTINE TO DISPLAY DETECT MODE AND BFO FREQUENCY
 WJ1 DETECT MODE IN DISPLAY FORMAT
 WJ2 BFO FREQUENCY (LOWER) IN DISPLAY FORMAT

 SAVE RETURN ADDRESS
 SAVE DETECT MODE
 SAVE BFO FREQUENCY
 GET ADDRESS OF EUFFER TO OUTPUT
 OUTPUT BUFFER
 GET DETECT MODE
 GET ADDRESS OF DETECT MODE TABLE
 OUTPUT BUFFER
 GET ADDRESS OF EUFFER TO OUTPUT
 OUTPUT BUFFER
 GET BFO FREQUENCY

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------------|---------|
| 0833 | 4002 | LDR | 638 |
| 0834 | F831 | SHD | 639 |
| 0835 | AE32 | SHS | 640 |
| 0836 | F831 | SHD | 641 |
| 0837 | A502 | IOR | 642 |
| 0839 | 9C02 | STR | 643 |
| 083B | 0AF5 | IS, WJV2, 03030 | 644 |
| 083C | | D, WJV2, 03030 | 645 |
| 083D | | IS, WJV2, 0 | 646 |
| 083E | | LL, WJV1, 4 | 647 |
| 083F | | SHS | 648 |
| 0841 | A502 | IOR | 649 |
| 0843 | 9C02 | STR | 650 |
| 0845 | 0AF6 | D, WJV2, WJDBF+1 | 651 |
| 0847 | E101 | LDR | 652 |
| 0849 | 0230 | BAL | 653 |
| | 09F1 | I, RET, WJ90R | 654 |
| | BF07 | R, 7, RET | 655 |
| | | BRC | 656 |
| | | | 657 |
| | | | 658 |
| | | | 659 |
| | | | 660 |
| | | | 661 |
| | | | 662 |
| 084A | 9C00 | STR | 663 |
| 084C | 4002 | LDR | 664 |
| 084D | F871 | SHD | 665 |
| 084E | A502 | IOR | 666 |
| 0850 | 2030 | STR | 667 |
| 0852 | 0B13 | D, WJV2, WJDRF1 | 668 |
| 0853 | | IS, WJV2, 0 | 669 |
| 0854 | | LL, WJV1, 4 | 670 |
| 0855 | | SHS | 671 |
| 0856 | | STR | 672 |
| 0858 | A502 | IOR | 673 |
| 085A | 3030 | D, WJV2, WJDRF+1 | 674 |
| 085C | 0B14 | STR | 675 |
| 085E | E101 | LDR | 676 |
| 0860 | 0230 | BAL | 677 |
| | 09F1 | I, RET, WJ90R | 678 |
| | BF07 | R, 7, RET | 679 |
| | | BRC | 680 |
| | | | 681 |
| | | | 682 |
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CLEAR REGISTER
 POSITION UPPER 2 DIGITS
 CONVERT TO ASCII
 STORE IN OUTPUT BUFFER
 CLEAR REGISTER
 POSITION LOWER 2 DIGITS
 CONVERT TO ASCII
 STORE IN OUTPUT BUFFER
 GET ADDRESS OF BUFFER TO OUTPUT
 OUTPUT BUFFER
 GET RETURN ADDRESS
 RETURN TO CALLER

ROUTINE TO DISPLAY RF GAIN
 WJ1 RF GAIN IN DISPLAY FORMAT

WJ95
 STR D, RET, WJ90R
 LDR IS, WJV2, 0
 SHD LL, WJV1, 8
 IOR I, WJV2, 02030
 STR D, WJV2, WJDRF1
 LDR IS, WJV2, 0
 SHD LL, WJV1, 4
 SHS LL, WJV2, 4
 IOR I, WJV2, 03030
 STR D, WJV2, WJDRF+1
 LDR I, WJV1, WJDRF
 BAL I, RET, WJ90R
 LDR D, RET, WJ90R
 R, 7, RET
 BRC

ROUTINE TO INCREMENT FREQUENCY
 WJ1 FREQUENCY IN DISPLAY FORMAT (LOWER)
 WJ2 FREQUENCY IN DISPLAY FORMAT (UPPER)
 WJ3 FREQUENCY INCREMENT IN DISPLAY FORMAT (LOWER)
 WJ4 FREQUENCY INCREMENT IN DISPLAY FORMAT (UPPER)
 WJ5 ANSWER FREQUENCY IN DISPLAY FORMAT (LOWER)
 WJ6 ANSWER FREQUENCY IN DISPLAY FORMAT (UPPER)

03/18/77

TIME: 16:43:42

ATAC

| LOC | OBJECT CODE | CARD IMAGE | SAVE RETURN ADDRESS SET UP MASK CLEAR REGISTER DO 1ST DIGIT DO 2ND DIGIT DO 3RD DIGIT DO 4TH DIGIT DO 5TH DIGIT DO 6TH DIGIT DO 7TH DIGIT | CARDNUM | PAGE |
|------|-------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|
| C861 | 9C00 | 09F1 | STR | D, RET, WJ90R | 691 |
| C862 | E109 | 000F | LDR | I, WJ95, 0 | 692 |
| C863 | 4005 | | LDR | IS, WJ95, 0 | 693 |
| C864 | 4006 | | LDR | IS, WJ95, 0 | 694 |
| C865 | E017 | | LDR | R, WJ97, WJ91 | 695 |
| C866 | E038 | 08A4 | LDR | R, WJ98, WJ93 | 696 |
| C867 | E017 | | LDR | I, RET, WJ961 | 697 |
| C868 | E000 | 08A4 | LDR | R, WJ95, WJ97 | 698 |
| C869 | E075 | | LDR | R, WJ97, WJ91 | 699 |
| C870 | E037 | | LDR | RL, WJ97, 4 | 700 |
| C871 | AD37 | | SHS | RL, WJ97, 4 | 701 |
| C872 | E087 | | ADD | R, WJ97, WJ98 | 702 |
| C873 | E038 | | LDR | R, WJ98, WJ93 | 703 |
| C874 | AD38 | | SHS | RL, WJ98, 4 | 704 |
| C875 | AD38 | 08A4 | BAL | I, RET, WJ961 | 705 |
| C876 | AD37 | | SHS | LL, WJ97, 4 | 706 |
| C877 | A475 | | LDR | R, WJ95, WJ97 | 707 |
| C878 | E017 | | LDR | R, WJ97, WJ91 | 708 |
| C879 | AD77 | | SHS | RL, WJ97, 8 | 709 |
| C880 | E087 | | ADD | R, WJ97, WJ98 | 710 |
| C881 | E038 | | LDR | R, WJ98, WJ93 | 711 |
| C882 | AD78 | 08A4 | SHS | RL, WJ98, 8 | 712 |
| C883 | E000 | 08A4 | BAL | I, RET, WJ961 | 713 |
| C884 | AE77 | | SHS | LL, WJ97, 8 | 714 |
| C885 | AE77 | | LDR | R, WJ95, WJ97 | 715 |
| C886 | E017 | | LDR | R, WJ97, WJ91 | 716 |
| C887 | AD77 | | SHS | RL, WJ97, 12 | 717 |
| C888 | E087 | | ADD | R, WJ97, WJ98 | 718 |
| C889 | E038 | | LDR | R, WJ98, WJ93 | 719 |
| C890 | AD88 | | SHS | RL, WJ98, 12 | 720 |
| C891 | E000 | 08A4 | BAL | I, RET, WJ961 | 721 |
| C892 | AE77 | | SHS | LL, WJ97, 12 | 722 |
| C893 | AE77 | | LDR | R, WJ95, WJ97 | 723 |
| C894 | A475 | | LDR | R, WJ97, WJ91 | 724 |
| C895 | E027 | | SHS | R, WJ97, WJ98 | 725 |
| C896 | E087 | | ADD | R, WJ97, WJ98 | 726 |
| C897 | AD37 | 08A4 | LDR | R, WJ98, WJ94 | 727 |
| C898 | E048 | | SHS | I, RET, WJ961 | 728 |
| C899 | E076 | | LDR | R, WJ95, WJ97 | 729 |
| C900 | E027 | | SHS | RL, WJ97, 4 | 730 |
| C901 | AD37 | | SHS | R, WJ97, WJ98 | 731 |
| C902 | E048 | | LDR | R, WJ98, WJ94 | 732 |
| C903 | AD38 | | SHS | RL, WJ98, 4 | 733 |
| C904 | E000 | 08A4 | BAL | I, RET, WJ961 | 734 |
| C905 | AE37 | | SHS | LL, WJ97, 4 | 735 |
| C906 | AE37 | | LDR | R, WJ95, WJ97 | 736 |
| C907 | E027 | | SHS | RL, WJ97, 8 | 737 |
| C908 | AD77 | | SHS | R, WJ97, WJ98 | 738 |
| C909 | E087 | | ADD | R, WJ97, WJ98 | 739 |
| C910 | E048 | | LDR | R, WJ98, WJ94 | 740 |
| C911 | AD78 | 08A4 | SHS | RL, WJ98, 8 | 741 |
| C912 | AD78 | | SHS | I, RET, WJ961 | 742 |
| C913 | AE77 | | SHS | LL, WJ97, 8 | 743 |

| LOC | OBJECT CODE | CARD IMAGE | DO LAST DIGIT | GET RETURN ADDRESS | RETURN | CLEAR ALL BUT DIGIT | CLEAR ALL BUT DIGIT | ADD DIGITS TOGETHER | CLEAR REGISTER | COMPARE WITH DECIMAL 10 | LESS NO CARRY | DECREMENT ANSWER BY 10 | CARRY ONE | RETURN TO CALLER | CARDNUM |
|------|-------------|------------|---------------|--------------------|--------|---------------------|---------------------|---------------------|----------------|-------------------------|---------------|------------------------|-----------|------------------|---------|
| 089E | A476 | IOR | R, WJ96 | WJ97 | | | | | | | | | | | 744 |
| 089F | AE88 | SIS | LL, WJ98 | 12 | | | | | | | | | | | 745 |
| 08A0 | A486 | IOR | R, WJ96 | WJ98 | | | | | | | | | | | 746 |
| 08A1 | E200 | LDR | D, RET | WJ90R | | | | | | | | | | | 747 |
| 08A3 | BF07 | BRC | R, 7, RET | | | | | | | | | | | | 748 |
| 08A4 | A097 | AND | R, WJ97 | WJ99 | | | | | | | | | | | 749 |
| 08A5 | A098 | AND | R, WJ98 | WJ99 | | | | | | | | | | | 750 |
| 08A6 | 8087 | ADD | R, WJ97 | WJ98 | | | | | | | | | | | 751 |
| 08A7 | 4008 | LDR | IS, WJ98 | 0 | | | | | | | | | | | 752 |
| 08A8 | 20A7 | CMPL | IS, WJ97 | 10 | | | | | | | | | | | 753 |
| 08A9 | C104 | BRCL | LT, WJ962 | | | | | | | | | | | | 754 |
| 08AB | 6F67 | ADD | IS, WJ97 | -10 | | | | | | | | | | | 755 |
| 08AC | 4018 | LDR | IS, WJ98 | 1 | | | | | | | | | | | 756 |
| 08AD | BF07 | BRC | R, 7, RET | | | | | | | | | | | | 757 |
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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|-----------------|---------|
| 0925 | R831 | SHD | 850 |
| 0926 | A102 | AND | 851 |
| 0928 | 9C01 | STR | 852 |
| 092A | 9C02 | STR | 853 |
| 092C | 9C01 | LDR | 854 |
| 092E | A101 | AND | 855 |
| 0930 | AD11 | SHS | 856 |
| 0931 | 9C01 | STR | 857 |
| 0933 | E201 | LDR | 858 |
| 0935 | E202 | LDR | 859 |
| 0937 | F801 | SHD | 860 |
| 0938 | 9C02 | STR | 861 |
| 093A | 9C02 | STR | 862 |
| 093C | A101 | AND | 863 |
| 093E | AD01 | SHS | 864 |
| 093F | 9C01 | STR | 865 |
| 0941 | E101 | LDR | 866 |
| 0943 | 9C01 | STR | 867 |
| 0945 | E201 | LDR | 868 |
| 0947 | A101 | AND | 869 |
| 0949 | 4002 | LDR | 870 |
| 094A | CD01 | MUL | 871 |
| 094C | E103 | LDR | 872 |
| 094E | F801 | ADD | 873 |
| 0950 | FC31 | DIV | 874 |
| 0951 | 8102 | ADD | 875 |
| 0953 | 4003 | LDR | 876 |
| 0954 | 40A4 | LDR | 877 |
| 0955 | EC42 | DIV | 878 |
| 0956 | E021 | LDR | 879 |
| 0957 | E032 | LDR | 880 |
| 0958 | 4003 | LDR | 881 |
| 0959 | FC42 | DIV | 882 |
| 095A | AE32 | SHS | 883 |
| 095B | A421 | IOR | 884 |
| 095C | E032 | LDR | 885 |
| 095D | 4003 | LDR | 886 |
| 095E | FC42 | DIV | 887 |
| 095F | AE72 | SHS | 888 |
| 0960 | AE83 | SHS | 889 |
| 0961 | A421 | IOR | 890 |
| 0962 | A431 | IOR | 891 |
| 0963 | 9C01 | STR | 892 |
| 0965 | E202 | LDR | 893 |
| 0967 | A102 | AND | 894 |
| 0969 | AD72 | SHS | 895 |
| 096A | B421 | LIC | 896 |
| 096B | A101 | AND | 897 |
| 096D | ED00 | EAL | 898 |
| 096F | 9C01 | STR | 899 |
| 0971 | E0C1 | LDR | 900 |
| 0973 | A101 | AND | 901 |
| 0975 | ED00 | BAL | 902 |
| | | RL, WJVI, 4 | |
| | | I, WJVI, 03FF | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRFU | |
| | | D, WJVI, WJRS2 | |
| | | I, WJVI, 0C | |
| | | RL, WJVI, 2 | |
| | | D, WJVI, WJRGH | |
| | | D, WJVI, WJRS3 | |
| | | D, WJVI, WJRS2 | |
| | | LL, WJVI, 1 | |
| | | I, WJVI, 07 | |
| | | D, WJVI, WJRF | |
| | | I, WJVI, 0E000 | |
| | | RL, WJVI, 13 | |
| | | D, WJVI, WJRDH | |
| | | I, WJVI, 04 | |
| | | D, WJVI, WJRBH | |
| | | D, WJVI, WJRS3 | |
| | | I, WJVI, 07FF | |
| | | IS, WJVI, 0 | |
| | | I, WJVI, 07D0 | |
| | | I, WJVI, 07FF | |
| | | R, WJVI, 0400 | |
| | | R, WJVI, WJV3 | |
| | | I, WJVI, 01194 | |
| | | IS, WJVI, 0 | |
| | | IS, WJVI, 10 | |
| | | R, WJVI, WJV4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | R, WJVI, WJV4 | |
| | | LL, WJVI, 4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | LL, WJVI, WJV4 | |
| | | LL, WJVI, 8 | |
| | | LL, WJVI, 12 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRS4 | |
| | | I, WJVI, 07P00 | |
| | | RL, WJVI, 8 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, 07F | |
| | | I, RET, WJRS3 | |
| | | D, WJVI, WJRRFG | |
| | | I, WJVI, WJRS4 | |
| | | I, RET, WJRS3 | |
| | | RL, WJVI, 4 | |
| | | I, WJVI, 03FF | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRFU | |
| | | D, WJVI, WJRS2 | |
| | | I, WJVI, 0C | |
| | | RL, WJVI, 2 | |
| | | D, WJVI, WJRGH | |
| | | D, WJVI, WJRS3 | |
| | | D, WJVI, WJRS2 | |
| | | LL, WJVI, 1 | |
| | | I, WJVI, 07 | |
| | | D, WJVI, WJRF | |
| | | I, WJVI, 0E000 | |
| | | RL, WJVI, 13 | |
| | | D, WJVI, WJRDH | |
| | | I, WJVI, 04 | |
| | | D, WJVI, WJRBH | |
| | | D, WJVI, WJRS3 | |
| | | I, WJVI, 07FF | |
| | | IS, WJVI, 0 | |
| | | I, WJVI, 07D0 | |
| | | I, WJVI, 07FF | |
| | | R, WJVI, 0400 | |
| | | R, WJVI, WJV3 | |
| | | I, WJVI, 01194 | |
| | | IS, WJVI, 0 | |
| | | IS, WJVI, 10 | |
| | | R, WJVI, WJV4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | R, WJVI, WJV4 | |
| | | LL, WJVI, 4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | LL, WJVI, WJV4 | |
| | | LL, WJVI, 8 | |
| | | LL, WJVI, 12 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRS4 | |
| | | I, WJVI, 07P00 | |
| | | RL, WJVI, 8 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, 07F | |
| | | I, RET, WJRS3 | |
| | | D, WJVI, WJRRFG | |
| | | I, WJVI, WJRS4 | |
| | | I, RET, WJRS3 | |
| | | RL, WJVI, 4 | |
| | | I, WJVI, 03FF | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRFU | |
| | | D, WJVI, WJRS2 | |
| | | I, WJVI, 0C | |
| | | RL, WJVI, 2 | |
| | | D, WJVI, WJRGH | |
| | | D, WJVI, WJRS3 | |
| | | D, WJVI, WJRS2 | |
| | | LL, WJVI, 1 | |
| | | I, WJVI, 07 | |
| | | D, WJVI, WJRF | |
| | | I, WJVI, 0E000 | |
| | | RL, WJVI, 13 | |
| | | D, WJVI, WJRDH | |
| | | I, WJVI, 04 | |
| | | D, WJVI, WJRBH | |
| | | D, WJVI, WJRS3 | |
| | | I, WJVI, 07FF | |
| | | IS, WJVI, 0 | |
| | | I, WJVI, 07D0 | |
| | | I, WJVI, 07FF | |
| | | R, WJVI, 0400 | |
| | | R, WJVI, WJV3 | |
| | | I, WJVI, 01194 | |
| | | IS, WJVI, 0 | |
| | | IS, WJVI, 10 | |
| | | R, WJVI, WJV4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | R, WJVI, WJV4 | |
| | | LL, WJVI, 4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | LL, WJVI, WJV4 | |
| | | LL, WJVI, 8 | |
| | | LL, WJVI, 12 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRS4 | |
| | | I, WJVI, 07P00 | |
| | | RL, WJVI, 8 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, 07F | |
| | | I, RET, WJRS3 | |
| | | D, WJVI, WJRRFG | |
| | | I, WJVI, WJRS4 | |
| | | I, RET, WJRS3 | |
| | | RL, WJVI, 4 | |
| | | I, WJVI, 03FF | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRFU | |
| | | D, WJVI, WJRS2 | |
| | | I, WJVI, 0C | |
| | | RL, WJVI, 2 | |
| | | D, WJVI, WJRGH | |
| | | D, WJVI, WJRS3 | |
| | | D, WJVI, WJRS2 | |
| | | LL, WJVI, 1 | |
| | | I, WJVI, 07 | |
| | | D, WJVI, WJRF | |
| | | I, WJVI, 0E000 | |
| | | RL, WJVI, 13 | |
| | | D, WJVI, WJRDH | |
| | | I, WJVI, 04 | |
| | | D, WJVI, WJRBH | |
| | | D, WJVI, WJRS3 | |
| | | I, WJVI, 07FF | |
| | | IS, WJVI, 0 | |
| | | I, WJVI, 07D0 | |
| | | I, WJVI, 07FF | |
| | | R, WJVI, 0400 | |
| | | R, WJVI, WJV3 | |
| | | I, WJVI, 01194 | |
| | | IS, WJVI, 0 | |
| | | IS, WJVI, 10 | |
| | | R, WJVI, WJV4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | R, WJVI, WJV4 | |
| | | LL, WJVI, 4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | LL, WJVI, WJV4 | |
| | | LL, WJVI, 8 | |
| | | LL, WJVI, 12 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRS4 | |
| | | I, WJVI, 07P00 | |
| | | RL, WJVI, 8 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, 07F | |
| | | I, RET, WJRS3 | |
| | | D, WJVI, WJRRFG | |
| | | I, WJVI, WJRS4 | |
| | | I, RET, WJRS3 | |
| | | RL, WJVI, 4 | |
| | | I, WJVI, 03FF | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRFU | |
| | | D, WJVI, WJRS2 | |
| | | I, WJVI, 0C | |
| | | RL, WJVI, 2 | |
| | | D, WJVI, WJRGH | |
| | | D, WJVI, WJRS3 | |
| | | D, WJVI, WJRS2 | |
| | | LL, WJVI, 1 | |
| | | I, WJVI, 07 | |
| | | D, WJVI, WJRF | |
| | | I, WJVI, 0E000 | |
| | | RL, WJVI, 13 | |
| | | D, WJVI, WJRDH | |
| | | I, WJVI, 04 | |
| | | D, WJVI, WJRBH | |
| | | D, WJVI, WJRS3 | |
| | | I, WJVI, 07FF | |
| | | IS, WJVI, 0 | |
| | | I, WJVI, 07D0 | |
| | | I, WJVI, 07FF | |
| | | R, WJVI, 0400 | |
| | | R, WJVI, WJV3 | |
| | | I, WJVI, 01194 | |
| | | IS, WJVI, 0 | |
| | | IS, WJVI, 10 | |
| | | R, WJVI, WJV4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | R, WJVI, WJV4 | |
| | | LL, WJVI, 4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | LL, WJVI, WJV4 | |
| | | LL, WJVI, 8 | |
| | | LL, WJVI, 12 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRS4 | |
| | | I, WJVI, 07P00 | |
| | | RL, WJVI, 8 | |
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| | | R, WJVI, 07F | |
| | | I, RET, WJRS3 | |
| | | D, WJVI, WJRRFG | |
| | | I, WJVI, WJRS4 | |
| | | I, RET, WJRS3 | |
| | | RL, WJVI, 4 | |
| | | I, WJVI, 03FF | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRFU | |
| | | D, WJVI, WJRS2 | |
| | | I, WJVI, 0C | |
| | | RL, WJVI, 2 | |
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| | | LL, WJVI, 1 | |
| | | I, WJVI, 07 | |
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| | | I, WJVI, 0E000 | |
| | | RL, WJVI, 13 | |
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| | | I, WJVI, 04 | |
| | | D, WJVI, WJRBH | |
| | | D, WJVI, WJRS3 | |
| | | I, WJVI, 07FF | |
| | | IS, WJVI, 0 | |
| | | I, WJVI, 07D0 | |
| | | I, WJVI, 07FF | |
| | | R, WJVI, 0400 | |
| | | R, WJVI, WJV3 | |
| | | I, WJVI, 01194 | |
| | | IS, WJVI, 0 | |
| | | IS, WJVI, 10 | |
| | | R, WJVI, WJV4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | R, WJVI, WJV4 | |
| | | LL, WJVI, 4 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | IS, WJVI, 0 | |
| | | LL, WJVI, WJV4 | |
| | | LL, WJVI, 8 | |
| | | LL, WJVI, 12 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, WJV3 | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRS4 | |
| | | I, WJVI, 07P00 | |
| | | RL, WJVI, 8 | |
| | | R, WJVI, WJV2 | |
| | | R, WJVI, 07F | |
| | | I, RET, WJRS3 | |
| | | D, WJVI, WJRRFG | |
| | | I, WJVI, WJRS4 | |
| | | I, RET, WJRS3 | |
| | | RL, WJVI, 4 | |
| | | I, WJVI, 03FF | |
| | | D, WJVI, WJREL | |
| | | D, WJVI, WJRFU | |
| | | D, WJVI, WJRS2 | |
| | | I, WJVI, 0C | |
| | | RL, WJVI, 2 | |
| | | D, WJVI, WJRGH | </ |

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| ATAC | LOC | OBJECT CODE | CARD | IMAGE | CARDNUM | PAGE |
|------|-----------|-------------|----------------|-------|---------|------|
| 0977 | 9C01 09E9 | STR | D, WJVI, WJRSS | | 903 | |
| 0979 | E200 09F1 | LDR | D, RET, WJ90R | | 904 | |
| 097B | BF07 | ERC | R, 7, RET | | 905 | |
| 097C | CD01 0064 | MUL | I, WJVI, 064 | | 906 | |
| 097E | 6371 | ADD | IS, WJVI, 037 | | 907 | |
| 097F | 47F3 | LDR | IS, WJVI, 07F3 | | 908 | |
| 0980 | FC31 | DIV | R, WJVI, WJV3 | | 909 | |
| 0981 | E021 | LDR | R, WJVI, WJV2 | | 910 | |
| 0982 | 4002 | LDR | IS, WJV2, 0 | | 911 | |
| 0983 | 40A3 | LDR | IS, WJV3, 10 | | 912 | |
| 0984 | FC31 | DIV | R, WJVI, WJV3 | | 913 | |
| 0985 | E014 | LDR | R, WJV4, WJVI | | 914 | |
| 0986 | E021 | LDR | R, WJVI, WJV2 | | 915 | |
| 0987 | 4002 | LDR | IS, WJV2, 0 | | 916 | |
| 0988 | FC31 | DIV | R, WJVI, WJV3 | | 917 | |
| 0989 | BE31 | SHS | LL, WJV1, 8 | | 918 | |
| 098A | AE72 | SHS | LL, WJV2, 8 | | 919 | |
| 098B | A441 | IOR | R, WJVI, WJV4 | | 920 | |
| 098C | A421 | IOR | R, WJVI, WJV2 | | 921 | |
| 098D | BF07 | BRC | R, 7, RET | | 922 | |
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| LOC | OBJECT CODE | CARD IMAGE | RCVR CONTROL WORD | CARDNUM |
|------|-------------|-----------------------------------|-------------------|---------|
| 09C8 | | WJCM1 DS 1 | 1 | 1008 |
| 09C9 | | WJCM2 DS 1 | 2 | 1009 |
| 09CA | | WJCM3 DS 1 | 3 | 1010 |
| 09CB | | WJCM4 DS 1 | 4 | 1011 |
| 09CC | | RECEIVED WORD FROM WJ | | 1012 |
| 09CD | | WJRS1 LS 1 | 1 | 1013 |
| 09CE | | WJRS2 DS 1 | 2 | 1014 |
| 09CF | | WJRS3 DS 1 | 3 | 1015 |
| | | WJRS4 DS 1 | 4 | 1016 |
| 09D0 | | TENTATIVE VALUES - DISPLAY FORMAT | | 1017 |
| 09D1 | | WJTF1 DS 1 | | 1018 |
| 09D2 | | WJTF2 DS 1 | | 1019 |
| 09D3 | | WJTF3 DS 1 | | 1020 |
| 09D4 | | WJTF4 DS 1 | | 1021 |
| 09D5 | | WJTF5 DS 1 | | 1022 |
| 09D6 | | WJTF6 DS 1 | | 1023 |
| 09D7 | | WJTF7 DS 1 | | 1024 |
| 09D8 | | CONTROL VALUES - DISPLAY FORMAT | | 1025 |
| 09D9 | | WJCP1 DS 1 | | 1026 |
| 09DA | | WJCP2 DS 1 | | 1027 |
| 09DB | | WJCP3 DS 1 | | 1028 |
| 09DC | | WJCP4 DS 1 | | 1029 |
| 09DD | | WJCP5 DS 1 | | 1030 |
| 09DE | | WJCP6 DS 1 | | 1031 |
| 09DF | | RECEIVED VALUES - DISPLAY FORMAT | | 1032 |
| 09E0 | | WJRF1 DS 1 | | 1033 |
| 09E1 | | WJRF2 DS 1 | | 1034 |
| 09E2 | | WJRF3 DS 1 | | 1035 |
| 09E3 | | WJRF4 DS 1 | | 1036 |
| 09E4 | | WJRF5 DS 1 | | 1037 |
| 09E5 | | WJRF6 DS 1 | | 1038 |
| 09E6 | | WJRF7 DS 1 | | 1039 |
| 09E7 | | WJRF8 DS 1 | | 1040 |
| 09E8 | | WJRF9 DS 1 | | 1041 |
| 09E9 | | WJRF10 DS 1 | | 1042 |
| 09EA | | SCAN VARIABLES | | 1043 |
| 09EB | | WJSF1 DS 1 | | 1044 |
| 09EC | | WJSF2 DS 1 | | 1045 |
| 09ED | | WJSF3 DS 1 | | 1046 |
| 09EE | | WJSF4 DS 1 | | 1047 |
| 09EF | | WJSF5 DS 1 | | 1048 |
| 09F0 | | WJSF6 DS 1 | | 1049 |
| | | WJSF7 DS 1 | | 1050 |
| | | WJSF8 DS 1 | | 1051 |
| | | WJSF9 DS 1 | | 1052 |
| | | WJSF10 DS 1 | | 1053 |
| | | WJSF11 DS 1 | | 1054 |
| | | WJSF12 DS 1 | | 1055 |
| | | WJSF13 DS 1 | | 1056 |
| | | WJSF14 DS 1 | | 1057 |
| | | WJSF15 DS 1 | | 1058 |
| | | WJSF16 DS 1 | | 1059 |
| | | WJSF17 DS 1 | | 1060 |

SAVE LOCATIONS FOR ALL WJ9- ROUTINES

| LOC | OBJECT CODE | CARD IMAGE | LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|-----|-------------|------------|---------|
| 09F1 | WJ90R | DS | 1 | 0009 | DC | 1061 |
| 09F2 | WJ90S1 | DS | 1 | 0D0A | DC | 1062 |
| 09F3 | WJ90S2 | DS | 1 | 5245 | DC | 1063 |
| 09F4 | CHKFIG1 | DS | 1 | 4345 | DC | 1064 |
| 09F5 | WJLPL | DS | 1 | 4956 | DC | 1065 |
| 09F6 | WJLPLK | DS | 1 | 4552 | DC | 1066 |
| | | | | 2043 | DC | 1067 |
| | | | | 4F4E | DC | 1068 |
| | | | | 5452 | DC | 1069 |
| | | | | 4F4C | DC | 1070 |
| | | | | 0000 | DC | 1071 |
| 09F7 | WJT | DC | 9 | 000A | DC | 1072 |
| 09F8 | | DC | | 05245 | DC | 1073 |
| 09F9 | | DC | | 04345 | DC | 1074 |
| 09FA | | DC | | 04956 | DC | 1075 |
| 09FB | | DC | | 04552 | DC | 1076 |
| 09FC | | DC | | 02043 | DC | 1077 |
| 09FD | | DC | | 04F4E | DC | 1078 |
| 09FE | | DC | | 05452 | DC | 1079 |
| 09FF | | DC | | 04F4C | DC | 1080 |
| 0A00 | | DC | | | DC | 1081 |
| 0A01 | | DC | | | DC | 1082 |
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| | | | | | DC | 1113 |

| ATAC | LOC | OBJECT CODE | CARD IMAGE | GAIN MODE | TITLE BUFFER | COUNT | CARDNUM | PAGE |
|------|------|-------------|------------|-----------|--------------|-------|---------|------|
| | 0A53 | 0018 | DC | 24 | 04741 | GA | 1167 | |
| | 0A54 | 4741 | DC | 04741 | IN | GA | 1168 | |
| | 0A55 | 494E | DC | 0494E | H | IN | 1169 | |
| | 0A56 | 204D | DC | 0204D | OD | H | 1170 | |
| | 0A57 | 4F44 | DC | 04F44 | ECR | OD | 1171 | |
| | 0A58 | 450D | DC | 0450D | LF0 | ECR | 1172 | |
| | 0A59 | 0A30 | DC | 00A30 | =H | LF0 | 1173 | |
| | 0A5A | 3D48 | DC | 03D48 | OL | =H | 1174 | |
| | 0A5B | 4F4C | DC | 04F4C | D | OL | 1175 | |
| | 0A5C | 4420 | DC | 04420 | AG | D | 1176 | |
| | 0A5D | 4147 | DC | 04147 | CCR | AG | 1177 | |
| | 0A5E | 430D | DC | 0430D | LF2 | CCR | 1178 | |
| | 0A5F | 0A32 | DC | 00A32 | =N | LF2 | 1179 | |
| | 0A60 | 3D4E | DC | 03D4E | OR | =N | 1180 | |
| | 0A61 | 4F52 | DC | 04F52 | MA | OR | 1181 | |
| | 0A62 | 4D41 | DC | 04D41 | L | MA | 1182 | |
| | 0A63 | 4C20 | DC | 04C20 | AG | L | 1183 | |
| | 0A64 | 4147 | DC | 04147 | CCR | AG | 1184 | |
| | 0A65 | 430D | DC | 0430D | LF3 | CCR | 1185 | |
| | 0A66 | 0A33 | DC | 00A33 | =M | LF3 | 1186 | |
| | 0A67 | 3D4D | DC | 03D4D | AN | =M | 1187 | |
| | 0A68 | 414E | DC | 0414E | UA | AN | 1188 | |
| | 0A69 | 5541 | DC | 05541 | L | UA | 1189 | |
| | 0A6A | 4C20 | DC | 04C20 | CR/LF | L | 1190 | |
| | 0A6B | 0D0A | DC | 00D0A | NULL | CR/LF | 1191 | |
| | 0A6C | 0000 | DC | 00000 | COUNT | NULL | 1192 | |
| | | | | | | | 1193 | |
| | | | | | | | 1194 | |
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| | 0A6D | 001A | DC | 26 | 04946 | IF | 1197 | |
| | 0A6E | 4946 | DC | 04946 | B | IF | 1198 | |
| | 0A6F | 2042 | DC | 02042 | AN | B | 1199 | |
| | 0A70 | 414E | DC | 0414E | DW | AN | 1200 | |
| | 0A71 | 4457 | DC | 04457 | ID | DW | 1201 | |
| | 0A72 | 4944 | DC | 04944 | TH | ID | 1202 | |
| | 0A73 | 5448 | DC | 05448 | CR/LF | TH | 1203 | |
| | 0A74 | 0D0A | DC | 00D0A | I= | CR/LF | 1204 | |
| | 0A75 | 313D | DC | 0313D | 50 | I= | 1205 | |
| | 0A76 | 3530 | DC | 03530 | 0 | 50 | 1206 | |
| | 0A77 | 3020 | DC | 03020 | HZ | 0 | 1207 | |
| | 0A78 | 485A | DC | 0485A | 2= | HZ | 1208 | |
| | 0A79 | 0D0A | DC | 00D0A | 2 | 2= | 1209 | |
| | 0A7A | 323D | DC | 0323D | 2 | 2 | 1210 | |
| | 0A7B | 3220 | DC | 03220 | KH | 2 | 1211 | |
| | 0A7C | 4B48 | DC | 04B48 | ZCR | KH | 1212 | |
| | 0A7D | 5A0D | DC | 05A0D | LF3 | ZCR | 1213 | |
| | 0A7E | 0A33 | DC | 00A33 | =4 | LF3 | 1214 | |
| | 0A7F | 3D34 | DC | 03D34 | K | =4 | 1215 | |
| | 0A80 | 204B | DC | 0204B | HZ | K | 1216 | |
| | 0A81 | 485A | DC | 0485A | 4= | HZ | 1217 | |
| | 0A82 | 0D0A | DC | 00D0A | 8 | 4= | 1218 | |
| | 0A83 | 343D | DC | 0343D | | | 1219 | |
| | 0A84 | 3820 | DC | 03820 | | | 1219 | |

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CARDNUM

CARD IMAGE

OBJECT CODE

LOC

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0A85 | 4B48 | DC | 1220 |
| 0A86 | 5A20 | DC | 1221 |
| 0A87 | 0D0A | LC | 1222 |
| 0A88 | 0000 | DC | 1223 |
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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0A89 | 0028 | DC | 1220 |
| 0A8A | 4445 | DC | 1221 |
| 0A8B | 5445 | EC | 1222 |
| 0A8C | 4354 | DC | 1223 |
| 0A8D | 204D | EC | 1224 |
| 0A8E | 4F44 | DC | 1225 |
| 0A8F | 450D | DC | 1226 |
| 0A90 | 0A30 | DC | 1227 |
| 0A91 | 3D41 | LC | 1228 |
| 0A92 | 4D0D | DC | 1229 |
| 0A93 | 0A31 | DC | 1230 |
| 0A94 | 3D46 | DC | 1231 |
| 0A95 | 4D0D | DC | 1232 |
| 0A96 | 0A32 | LC | 1233 |
| 0A97 | 3D42 | DC | 1234 |
| 0A98 | 464F | DC | 1235 |
| 0A99 | 2046 | DC | 1236 |
| 0A9A | 4958 | DC | 1237 |
| 0A9B | 4544 | DC | 1238 |
| 0A9C | 0D0A | DC | 1239 |
| 0A9D | 333D | DC | 1240 |
| 0A9E | 4246 | EC | 1241 |
| 0A9F | 4F20 | DC | 1242 |
| 0AA0 | 5641 | DC | 1243 |
| 0AA1 | 520D | DC | 1244 |
| 0AA2 | 0A34 | LC | 1245 |
| 0AA3 | 3D49 | DC | 1246 |
| 0AA4 | 5342 | DC | 1247 |
| 0AA5 | 0D0A | DC | 1248 |
| 0AA6 | 353D | DC | 1249 |
| 0AA7 | 4C53 | EC | 1250 |
| 0AA8 | 420D | DC | 1251 |
| 0AA9 | 0A36 | DC | 1252 |
| 0AAA | 3D55 | DC | 1253 |
| 0AAB | 5342 | EC | 1254 |
| 0AAC | 0D0A | DC | 1255 |
| 0AAD | 373D | EC | 1256 |
| 0AAE | 414D | DC | 1257 |
| 0AAF | 2D4E | DC | 1258 |
| 0AEO | 4C20 | LC | 1259 |
| 0AAI | 0D0A | DC | 1260 |
| 0AE2 | 0000 | DC | 1261 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0AB3 | 0015 | DC | 1262 |
| 0AB4 | 4246 | DC | 1263 |
| 0AB5 | 4F20 | DC | 1264 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0AB6 | 0015 | DC | 1265 |
| 0AB7 | 4246 | DC | 1266 |
| 0AB8 | 4F20 | DC | 1267 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0AB9 | 0015 | DC | 1268 |
| 0ABA | 4246 | DC | 1269 |
| 0ABB | 4F20 | DC | 1270 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1271 |
| 0ABD | 4246 | DC | 1272 |
| 0ABE | 4F20 | DC | 1273 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1274 |
| 0ABA | 4246 | DC | 1275 |
| 0ABB | 4F20 | DC | 1276 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1277 |
| 0ABD | 4246 | DC | 1278 |
| 0ABE | 4F20 | DC | 1279 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1280 |
| 0ABA | 4246 | DC | 1281 |
| 0ABB | 4F20 | DC | 1282 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1283 |
| 0ABD | 4246 | DC | 1284 |
| 0ABE | 4F20 | DC | 1285 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1286 |
| 0ABA | 4246 | DC | 1287 |
| 0ABB | 4F20 | DC | 1288 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1289 |
| 0ABD | 4246 | DC | 1290 |
| 0ABE | 4F20 | DC | 1291 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1292 |
| 0ABA | 4246 | DC | 1293 |
| 0ABB | 4F20 | DC | 1294 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1295 |
| 0ABD | 4246 | DC | 1296 |
| 0ABE | 4F20 | DC | 1297 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1298 |
| 0ABA | 4246 | DC | 1299 |
| 0ABB | 4F20 | DC | 1300 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1301 |
| 0ABD | 4246 | DC | 1302 |
| 0ABE | 4F20 | DC | 1303 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1304 |
| 0ABA | 4246 | DC | 1305 |
| 0ABB | 4F20 | DC | 1306 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1307 |
| 0ABD | 4246 | DC | 1308 |
| 0ABE | 4F20 | DC | 1309 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1310 |
| 0ABA | 4246 | DC | 1311 |
| 0ABB | 4F20 | DC | 1312 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1313 |
| 0ABD | 4246 | DC | 1314 |
| 0ABE | 4F20 | DC | 1315 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1316 |
| 0ABA | 4246 | DC | 1317 |
| 0ABB | 4F20 | DC | 1318 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1319 |
| 0ABD | 4246 | DC | 1320 |
| 0ABE | 4F20 | DC | 1321 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1322 |
| 0ABA | 4246 | DC | 1323 |
| 0ABB | 4F20 | DC | 1324 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1325 |
| 0ABD | 4246 | DC | 1326 |
| 0ABE | 4F20 | DC | 1327 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1328 |
| 0ABA | 4246 | DC | 1329 |
| 0ABB | 4F20 | DC | 1330 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1331 |
| 0ABD | 4246 | DC | 1332 |
| 0ABE | 4F20 | DC | 1333 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1334 |
| 0ABA | 4246 | DC | 1335 |
| 0ABB | 4F20 | DC | 1336 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1337 |
| 0ABD | 4246 | DC | 1338 |
| 0ABE | 4F20 | DC | 1339 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1340 |
| 0ABA | 4246 | DC | 1341 |
| 0ABB | 4F20 | DC | 1342 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1343 |
| 0ABD | 4246 | DC | 1344 |
| 0ABE | 4F20 | DC | 1345 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1346 |
| 0ABA | 4246 | DC | 1347 |
| 0ABB | 4F20 | DC | 1348 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1349 |
| 0ABD | 4246 | DC | 1350 |
| 0ABE | 4F20 | DC | 1351 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1352 |
| 0ABA | 4246 | DC | 1353 |
| 0ABB | 4F20 | DC | 1354 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1355 |
| 0ABD | 4246 | DC | 1356 |
| 0ABE | 4F20 | DC | 1357 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1358 |
| 0ABA | 4246 | DC | 1359 |
| 0ABB | 4F20 | DC | 1360 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1361 |
| 0ABD | 4246 | DC | 1362 |
| 0ABE | 4F20 | DC | 1363 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1364 |
| 0ABA | 4246 | DC | 1365 |
| 0ABB | 4F20 | DC | 1366 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1367 |
| 0ABD | 4246 | DC | 1368 |
| 0ABE | 4F20 | DC | 1369 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1370 |
| 0ABA | 4246 | DC | 1371 |
| 0ABB | 4F20 | DC | 1372 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1373 |
| 0ABD | 4246 | DC | 1374 |
| 0ABE | 4F20 | DC | 1375 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1376 |
| 0ABA | 4246 | DC | 1377 |
| 0ABB | 4F20 | DC | 1378 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1379 |
| 0ABD | 4246 | DC | 1380 |
| 0ABE | 4F20 | DC | 1381 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1382 |
| 0ABA | 4246 | DC | 1383 |
| 0ABB | 4F20 | DC | 1384 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1385 |
| 0ABD | 4246 | DC | 1386 |
| 0ABE | 4F20 | DC | 1387 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1388 |
| 0ABA | 4246 | DC | 1389 |
| 0ABB | 4F20 | DC | 1390 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1391 |
| 0ABD | 4246 | DC | 1392 |
| 0ABE | 4F20 | DC | 1393 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1394 |
| 0ABA | 4246 | DC | 1395 |
| 0ABB | 4F20 | DC | 1396 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1397 |
| 0ABD | 4246 | DC | 1398 |
| 0ABE | 4F20 | DC | 1399 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1400 |
| 0ABA | 4246 | DC | 1401 |
| 0ABB | 4F20 | DC | 1402 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1403 |
| 0ABD | 4246 | DC | 1404 |
| 0ABE | 4F20 | DC | 1405 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1406 |
| 0ABA | 4246 | DC | 1407 |
| 0ABB | 4F20 | DC | 1408 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 0015 | DC | 1409 |
| 0ABD | 4246 | DC | 1410 |
| 0ABE | 4F20 | DC | 1411 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABF | 0015 | DC | 1412 |
| 0ABA | 4246 | DC | 1413 |
| 0ABB | 4F20 | DC | 1414 |

| LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|-------------|------------|---------|
| 0ABC | 001 | | |

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| LOC | OBJECT CODE | CARD IMAGE | COUNT | CARDNUM |
|-----------------------------------|-------------|------------|-------|---------|
| 0AE5 | 0007 | DC | 7 | 1326 |
| 0AE6 | 4445 | DC | 04445 | 1327 |
| 0AE7 | 5445 | DC | 05445 | 1328 |
| 0AE8 | 4354 | DC | 04354 | 1329 |
| 0AE9 | 204D | DC | 0204D | 1330 |
| 0AEA | 4F44 | DC | 04F44 | 1331 |
| 0AEB | 4520 | DC | 04520 | 1332 |
| 0AEC | 3D20 | DC | 03D20 | 1333 |
| 0AED | 0000 | DC | 0 | 1334 |
| . BFO FREQUENCY TITLE FOR DISPLAY | | | | 1335 |
| 0AEE | 000B | DC | 11 | 1336 |
| 0AEF | 4246 | DC | 04246 | 1337 |
| 0AF0 | 4F20 | DC | 04F20 | 1338 |
| 0AF1 | 4652 | DC | 04652 | 1339 |
| 0AF2 | 4551 | DC | 04551 | 1340 |
| 0AF3 | 203D | DC | 0203D | 1341 |
| 0AF4 | 2034 | DC | 02034 | 1342 |
| 0AF5 | 2020 | DC | 02020 | 1343 |
| 0AF6 | 2020 | DC | 02020 | 1344 |
| 0AF7 | 3020 | DC | 03020 | 1345 |
| 0AF8 | 485A | DC | 0485A | 1346 |
| 0AP9 | 000A | DC | 00D0A | 1347 |
| 0AFA | 0000 | DC | 0 | 1348 |
| . GAIN MODE TITLE FOR DISPLAY | | | | 1349 |
| 0AFB | 0006 | DC | 6 | 1350 |
| 0AFC | 4741 | DC | 04741 | 1351 |
| 0AFD | 494E | DC | 0494E | 1352 |
| 0AFE | 204D | DC | 0204D | 1353 |
| 0AFF | 4F44 | DC | 04F44 | 1354 |
| 0B00 | 4520 | DC | 04520 | 1355 |
| 0B01 | 3D20 | DC | 03D20 | 1356 |
| 0B02 | 0000 | DC | 0 | 1357 |
| . IF BANDWIDTH TITLE FOR DISPLAY | | | | 1358 |
| 0B03 | 0008 | DC | 8 | 1359 |
| 0B04 | 4946 | DC | 04946 | 1360 |
| 0B05 | 2042 | DC | 02042 | 1361 |
| 0E06 | 414E | DC | 0414E | 1362 |
| 0B07 | 4457 | DC | 04457 | 1363 |
| 0B08 | 4944 | DC | 04944 | 1364 |
| 0B09 | 5448 | DC | 05448 | 1365 |
| 0E0A | 203D | DC | 0203D | 1366 |
| 0B0B | 2020 | DC | 02020 | 1367 |
| 0B0C | 0000 | DC | 0 | 1368 |
| . RF GAIN TITLE FOR DISPLAY | | | | 1369 |
| 0B0D | 0009 | DC | 9 | 1370 |
| 0B0E | 5246 | DC | 05246 | 1371 |
| 0B0F | 2047 | DC | 02047 | 1372 |
| 0B10 | 4149 | DC | 04149 | 1373 |
| 0B11 | 4E20 | DC | 04E20 | 1374 |
| COUNT | | | | 1375 |
| DE | | | | 1376 |
| TE | | | | 1377 |
| CT | | | | 1378 |
| M | | | | |
| OD | | | | |
| E | | | | |
| = | | | | |
| NULL | | | | |
| COUNT | | | | |
| BF | | | | |
| O | | | | |
| FR | | | | |
| EQ | | | | |
| = | | | | |
| 4 | | | | |
| XX | | | | |
| XX | | | | |
| O | | | | |
| RZ | | | | |
| CR/IF | | | | |
| NULL | | | | |
| COUNT | | | | |
| GA | | | | |
| IN | | | | |
| M | | | | |
| OD | | | | |
| E | | | | |
| = | | | | |
| NULL | | | | |
| COUNT | | | | |
| IF | | | | |
| B | | | | |
| AN | | | | |
| DW | | | | |
| ID | | | | |
| TH | | | | |
| = | | | | |
| NULL | | | | |
| COUNT | | | | |
| RF | | | | |
| G | | | | |
| AI | | | | |
| N | | | | |

| ATAC | IOC | OBJECT CODE | CARD | IMAGE | CARDNUM |
|-------------------------------------|------|-------------|------|-------|---------|
| OB12 | 3D20 | | DC | 03D20 | 1379 |
| OB13 | 2020 | | DC | 02020 | 1380 |
| OB14 | 2020 | | DC | 02020 | 1381 |
| OB15 | 2520 | | DC | 02520 | 1382 |
| OB16 | 0D0A | | DC | 00D0A | 1383 |
| OB17 | 0000 | | DC | 0 | 1384 |
| . SIGNAL STRENGTH TITLE FOR DISPLAY | | | | | |
| OB18 | 000D | | DC | 13 | 1385 |
| OB19 | 5349 | | DC | 05349 | 1386 |
| OB1A | 474E | | DC | 0474E | 1387 |
| OB1B | 414C | | DC | 0414C | 1388 |
| OB1C | 2053 | | DC | 02053 | 1389 |
| OB1D | 5452 | | DC | 05452 | 1390 |
| OB1E | 454E | | DC | 0454E | 1391 |
| OB1F | 4754 | | DC | 04754 | 1392 |
| OB20 | 4820 | | DC | 04820 | 1393 |
| OB21 | 3D20 | | DC | 03D20 | 1394 |
| OB22 | 2020 | | DC | 02020 | 1395 |
| OB23 | 2020 | | DC | 02020 | 1396 |
| OB24 | 2520 | | DC | 02520 | 1397 |
| OB25 | 0D0A | | DC | 00D0A | 1398 |
| OB26 | 0000 | | DC | 0 | 1399 |
| . TABLE OF GAIN MODES FOR DISPLAY | | | | | |
| OB27 | 0B2B | | DC | WJGM0 | 1400 |
| OB28 | 0B32 | | DC | WJGM1 | 1401 |
| OB29 | 0B34 | | DC | WJGM2 | 1402 |
| OB2A | 0B3C | | DC | WJGM3 | 1403 |
| . WJGM0 | | | | | |
| OB2B | 0005 | | DC | 5 | 1404 |
| OB2C | 484F | | DC | 0484F | 1405 |
| OB2D | 4C44 | | DC | 04C44 | 1406 |
| OB2E | 2041 | | DC | 02041 | 1407 |
| OB2F | 4743 | | DC | 04743 | 1408 |
| OB30 | 0D0A | | DC | 00D0A | 1409 |
| OB31 | 0000 | | DC | 0 | 1410 |
| . WJGM1 | | | | | |
| OB32 | FFFF | | DC | -1 | 1411 |
| OB33 | 0000 | | DC | 0 | 1412 |
| . WJGM2 | | | | | |
| OB34 | 0006 | | DC | 6 | 1413 |
| OB35 | 4E4F | | DC | 04E4F | 1414 |
| OB36 | 524D | | DC | 0524D | 1415 |
| OB37 | 414C | | DC | 0414C | 1416 |
| OB38 | 2041 | | DC | 02041 | 1417 |
| OB39 | 4743 | | DC | 04743 | 1418 |
| OB3A | 0D0A | | DC | 00D0A | 1419 |
| OB3B | 0000 | | DC | 0 | 1420 |
| . COUNT/NORMAL AGC | | | | | |
| OB34 | 0006 | | DC | 6 | 1421 |
| OB35 | 4E4F | | DC | 04E4F | 1422 |
| OB36 | 524D | | DC | 0524D | 1423 |
| OB37 | 414C | | DC | 0414C | 1424 |
| OB38 | 2041 | | DC | 02041 | 1425 |
| OB39 | 4743 | | DC | 04743 | 1426 |
| OB3A | 0D0A | | DC | 00D0A | 1427 |
| OB3B | 0000 | | DC | 0 | 1428 |
| . COUNT/HOLD AGC | | | | | |
| OB34 | 0006 | | DC | 6 | 1429 |
| OB35 | 4E4F | | DC | 04E4F | 1430 |
| OB36 | 524D | | DC | 0524D | 1431 |
| OB37 | 414C | | DC | 0414C | 1432 |
| OB38 | 2041 | | DC | 02041 | 1433 |
| OB39 | 4743 | | DC | 04743 | 1434 |
| OB3A | 0D0A | | DC | 00D0A | 1435 |
| OB3B | 0000 | | DC | 0 | 1436 |

| ATAC | LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------------------------------------|-------|-------------|------------|---------|
| OB3C | 0004 | WJGM3 | DC | 1432 |
| OB3D | 04D41 | 4 | DC | 1433 |
| OB3E | 4E55 | 04E55 | DC | 1434 |
| OB3F | 414C | 0414C | DC | 1435 |
| OB40 | 0D0A | 00D0A | DC | 1436 |
| OB41 | 0000 | 0 | DC | 1437 |
| TABLE CF IF BANDWIDTHS FOR DISPLAY | | | | |
| OB42 | 0B47 | WJIF0 | DC | 1438 |
| OB43 | 0B49 | WJIF1 | DC | 1439 |
| OB44 | 0B4F | WJIF2 | DC | 1440 |
| OB45 | 0B55 | WJIF3 | DC | 1441 |
| OB46 | 0B5B | WJIF4 | DC | 1442 |
| NOT USED | | | | |
| OB47 | FFFF | -1 | DC | 1443 |
| OB48 | 0000 | 0 | DC | 1444 |
| COUNT/INVALID ENTRY | | | | |
| OB49 | 0004 | WJIF1 | DC | 1445 |
| OB4A | 3530 | 4 | DC | 1446 |
| OB4B | 3020 | 03530 | DC | 1447 |
| OB4C | 485A | 03020 | DC | 1448 |
| OB4D | 0D0A | 0485A | DC | 1449 |
| OB4E | 0000 | 00D0A | DC | 1450 |
| COUNT/500KHZ | | | | |
| OB4F | 0004 | WJIF2 | DC | 1451 |
| OB50 | 3220 | 4 | DC | 1452 |
| OB51 | 4B48 | 03220 | DC | 1453 |
| OB52 | 5A20 | 04B48 | DC | 1454 |
| OB53 | 0D0A | 05A20 | DC | 1455 |
| OB54 | 0000 | 00D0A | DC | 1456 |
| COUNT/2KHZ | | | | |
| OB55 | 0004 | WJIF3 | DC | 1457 |
| OB56 | 3420 | 4 | DC | 1458 |
| OB57 | 4B48 | 03420 | DC | 1459 |
| OB58 | 5A20 | 04B48 | DC | 1460 |
| OB59 | 0D0A | 05A20 | DC | 1461 |
| OB5A | 0000 | 00D0A | DC | 1462 |
| COUNT/4KHZ | | | | |
| OB5B | 0004 | WJIF4 | DC | 1463 |
| OB5C | 3820 | 4 | DC | 1464 |
| OB5D | 4B48 | 03820 | DC | 1465 |
| OB5E | 5A20 | 04B48 | DC | 1466 |
| OB5F | 0D0A | 05A20 | DC | 1467 |
| OB60 | 0000 | 00D0A | DC | 1468 |
| COUNT/8 KHZ | | | | |
| OB61 | 0B69 | WJDM1 | DC | 1469 |
| TABLE CF DETECT MODES FOR DISPLAY | | | | |
| OB61 | 0B69 | WJDM1 | DC | 1470 |
| OB62 | 0B69 | WJDM1 | DC | 1471 |
| OB63 | 0B69 | WJDM1 | DC | 1472 |
| OB64 | 0B69 | WJDM1 | DC | 1473 |
| OB65 | 0B69 | WJDM1 | DC | 1474 |
| OB66 | 0B69 | WJDM1 | DC | 1475 |
| OB67 | 0B69 | WJDM1 | DC | 1476 |
| OB68 | 0B69 | WJDM1 | DC | 1477 |
| OB69 | 0B69 | WJDM1 | DC | 1478 |
| OB70 | 0B69 | WJDM1 | DC | 1479 |
| OB71 | 0B69 | WJDM1 | DC | 1480 |
| OB72 | 0B69 | WJDM1 | DC | 1481 |
| OB73 | 0B69 | WJDM1 | DC | 1482 |
| OB74 | 0B69 | WJDM1 | DC | 1483 |
| OB75 | 0B69 | WJDM1 | DC | 1484 |

03/18/77

TIME: 16:43:42

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| LOC | OBJECT CODE | CARD IMAGE | CARDNUM | PAGE |
|------|-------------|------------|---------|------|
| 0B62 | 0B6D | DC | 1485 | |
| 0B63 | 0B71 | DC | 1486 | |
| 0B64 | 0B79 | DC | 1487 | |
| 0B65 | 0B82 | DC | 1488 | |
| 0B66 | 0B87 | DC | 1489 | |
| 0B67 | 0B8C | DC | 1490 | |
| 0B68 | 0B91 | LC | 1491 | |
| | | | 1492 | |
| | | | 1493 | |
| 0B69 | 0002 | DC | 1494 | |
| 0B6A | 414D | DC | 1495 | |
| 0B6B | 0D0A | DC | 1496 | |
| 0B6C | 0000 | DC | 1497 | |
| | | | 1498 | |
| | | | 1499 | |
| 0B6D | 0002 | DC | 1500 | |
| 0B6E | 464D | DC | 1501 | |
| 0B6F | 0D0A | DC | 1502 | |
| 0B70 | 0000 | DC | 1503 | |
| | | | 1504 | |
| | | | 1505 | |
| 0B71 | 0006 | DC | 1506 | |
| 0B72 | 4246 | DC | 1507 | |
| 0B73 | 4F20 | DC | 1508 | |
| 0B74 | 4649 | DC | 1509 | |
| 0B75 | 5845 | DC | 1510 | |
| 0B76 | 4420 | DC | 1511 | |
| 0B77 | 0D0A | DC | 1512 | |
| 0B78 | 0000 | DC | 1513 | |
| | | | 1514 | |
| | | | 1515 | |
| 0B79 | 0007 | DC | 1516 | |
| 0B7A | 4246 | DC | 1517 | |
| 0B7B | 4F20 | DC | 1518 | |
| 0B7C | 5641 | DC | 1519 | |
| 0B7D | 5249 | DC | 1520 | |
| 0B7E | 4142 | DC | 1521 | |
| 0B7F | 4C45 | DC | 1522 | |
| 0B80 | 0D0A | DC | 1523 | |
| 0B81 | 0000 | DC | 1524 | |
| | | | 1525 | |
| | | | 1526 | |
| 0B82 | 0003 | DC | 1527 | |
| 0B83 | 4953 | DC | 1528 | |
| 0B84 | 4220 | DC | 1529 | |
| 0B85 | 0D0A | DC | 1530 | |
| 0B86 | 0000 | DC | 1531 | |
| | | | 1532 | |
| | | | 1533 | |
| 0B87 | 0003 | DC | 1534 | |
| 0B88 | 4C53 | DC | 1535 | |
| 0B89 | 4220 | DC | 1536 | |
| 0B8A | 0D0A | DC | 1537 | |

| ATAC | LOC | OBJECT CODE | CARD IMAGE | CARDNUM |
|------|------|-------------|------------|---------|
| | OB8B | 0000 | DC 0 | 1538 |
| | OB8C | 0003 | EC 3 | 1539 |
| | OB8D | 5553 | DC 0 | 1540 |
| | OB8E | 4220 | DC 0 | 1541 |
| | OB8F | 0D0A | DC 0 | 1542 |
| | OB90 | 0000 | DC 0 | 1543 |
| | OB91 | 0004 | DC 4 | 1544 |
| | OB92 | 414D | DC 0 | 1545 |
| | OB93 | 2D4E | DC 0 | 1546 |
| | OB94 | 4C20 | DC 0 | 1547 |
| | OB95 | 0D0A | DC 0 | 1548 |
| | OB96 | 0000 | DC 0 | 1549 |
| | OB97 | 0003 | DC 3 | 1550 |
| | OB98 | 5343 | DC 0 | 1551 |
| | OB99 | 414E | DC 0 | 1552 |
| | OB9A | 0D0A | DC 0 | 1553 |
| | OB9B | 0000 | DC 0 | 1554 |
| | OB9C | 0009 | DC 9 | 1555 |
| | OB9D | 5354 | DC 0 | 1556 |
| | OB9E | 4152 | DC 0 | 1557 |
| | OB9F | 5420 | DC 0 | 1558 |
| | OB90 | 4652 | DC 0 | 1559 |
| | OB91 | 4551 | DC 0 | 1560 |
| | OB92 | 2049 | DC 0 | 1561 |
| | OB93 | 4E20 | DC 0 | 1562 |
| | OB94 | 485A | DC 0 | 1563 |
| | OB95 | 0D0A | DC 0 | 1564 |
| | OB96 | 0000 | DC 0 | 1565 |
| | OB97 | 0008 | DC 8 | 1566 |
| | OB98 | 454E | DC 0 | 1567 |
| | OB99 | 4420 | DC 0 | 1568 |
| | OB9A | 4652 | DC 0 | 1569 |
| | OB9B | 4551 | DC 0 | 1570 |
| | OB9C | 2049 | DC 0 | 1571 |
| | OB9D | 4E20 | DC 0 | 1572 |
| | OB9E | 485A | DC 0 | 1573 |
| | OB9F | 0D0A | DC 0 | 1574 |
| | OB90 | 0000 | DC 0 | 1575 |
| | OB91 | 000B | DC 11 | 1576 |
| | OB92 | 4652 | DC 0 | 1577 |
| | OB93 | 4551 | DC 0 | 1578 |
| | OB94 | 000B | DC 11 | 1579 |
| | OB95 | 4652 | DC 0 | 1580 |
| | OB96 | 4551 | DC 0 | 1581 |
| | OB97 | 000B | DC 11 | 1582 |
| | OB98 | 4652 | DC 0 | 1583 |
| | OB99 | 4551 | DC 0 | 1584 |
| | OB9A | 000B | DC 11 | 1585 |
| | OB9B | 4652 | DC 0 | 1586 |
| | OB9C | 4551 | DC 0 | 1587 |
| | OB9D | 000B | DC 11 | 1588 |
| | OB9E | 4652 | DC 0 | 1589 |
| | OB9F | 4551 | DC 0 | 1590 |

TIME: 16:43:42

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PAGE

CARDNUM

ATAC

| LOC | OBJECT CODE | CARD IMAGE | COUNT | CARDNUM |
|----------------------------|-------------|------------|-------|---------|
| 0BB4 | 2049 | DC | I | 1591 |
| 0BB5 | 4E43 | DC | NC | 1592 |
| 0BB6 | 5245 | DC | RE | 1593 |
| 0BB7 | 4D45 | DC | ME | 1594 |
| 0BB8 | 4E54 | DC | NI | 1595 |
| 0BB9 | 2049 | DC | I | 1596 |
| 0BBA | 4E20 | DC | N | 1597 |
| 0BBB | 485A | DC | HZ | 1598 |
| 0BBC | 0D0A | DC | CR/LF | 1599 |
| 0BED | 0000 | DC | NULL | 1600 |
| . SIGNAL STRENGTH TITLE | | | | |
| 0BBE | 000A | DC | COUNT | 1601 |
| 0BBF | 5349 | DC | SI | 1602 |
| 0BC0 | 474E | DC | GN | 1603 |
| 0BC1 | 414C | DC | AL | 1604 |
| 0BC2 | 2051 | DC | AS | 1605 |
| 0BC3 | 5452 | DC | TR | 1606 |
| 0BC4 | 454E | DC | EN | 1607 |
| 0BC5 | 4754 | DC | GT | 1608 |
| 0BC6 | 4820 | DC | H | 1609 |
| 0BC7 | 2520 | DC | % | 1610 |
| 0BC8 | 0D0A | DC | CR/LF | 1611 |
| 0BC9 | 0000 | DC | NULL | 1612 |
| . NO FIND MESSAGE FOR SCAN | | | | |
| 0BCA | 0006 | DC | COUNT | 1613 |
| 0BCB | 4E4F | DC | NO | 1614 |
| 0BCD | 2053 | DC | S | 1615 |
| 0BCE | 4947 | DC | IG | 1616 |
| 0BCF | 4E41 | DC | NA | 1617 |
| 0BD0 | 4C20 | DC | L | 1618 |
| 0BD1 | 000A | DC | CR/LF | 1619 |
| . LOOP MESSAGE | | | | |
| 0BD2 | 001D | DC | COUNT | 1620 |
| 0BD3 | 0707 | DC | BELL | 1621 |
| 0BD4 | 494E | DC | IN | 1622 |
| 0BD5 | 4649 | DC | FI | 1623 |
| 0BD6 | 4E49 | DC | NI | 1624 |
| 0BD7 | 5445 | DC | TE | 1625 |
| 0BD8 | 204C | DC | L | 1626 |
| 0BD9 | 4F4F | DC | OO | 1627 |
| 0BDA | 500D | DC | PCR | 1628 |
| 0BDB | 0A5D | DC | LFP | 1629 |
| 0BDC | 4C45 | DC | LE | 1630 |
| 0BD0 | 4153 | DC | AS | 1631 |
| 0BDE | 4520 | DC | EH | 1632 |
| 0BDF | 4348 | DC | CH | 1633 |
| 0BE0 | 4543 | DC | EC | 1634 |
| 0BE1 | 4820 | DC | K | 1635 |

| ATAC | LOC | OBJECT CODE | CARD | IMAGE | CARDNUM |
|------|------|-------------|------|-------|---------|
| 0BE2 | 494E | | DC | 0490E | 1644 |
| 0BE3 | 5445 | | DC | 05445 | 1645 |
| 0BE4 | 5246 | | DC | 05246 | 1646 |
| 0BE5 | 4143 | | DC | 04143 | 1647 |
| 0BE6 | 4520 | | DC | 04520 | 1648 |
| 0BE7 | 414E | | DC | 0414E | 1649 |
| 0BE8 | 4420 | | DC | 04420 | 1650 |
| 0BE9 | 5245 | | DC | 05245 | 1651 |
| 0BEA | 4345 | | DC | 04345 | 1652 |
| 0BEB | 4956 | | DC | 04956 | 1653 |
| 0BEC | 4552 | | DC | 04552 | 1654 |
| 0BED | C707 | | DC | 00707 | 1655 |
| 0BEE | 0D0A | | DC | 00D0A | 1656 |
| 0BEF | 0000 | | DC | 0000 | 1657 |
| | | | | | 1658 |
| | | | | | 1659 |

IN
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RF
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E
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ER
BELL
CR/LF
NULL

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5. Rosenberger, D. K., Signal Acquisition and Sampling using a Microprocessor, M.S. Thesis, United States Naval Postgraduate School, 1977.

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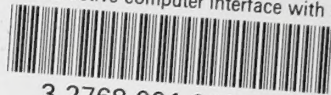
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puter interface with
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